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ABSTRACT

In December of 1978 the New York State Board of Regents ordered the New York State Education Department to conduct a detailed study of the way in which the subject of origins should be treated in a revised version of the Regents Biology Syllabus. The author was invited to supply scientific information to the Bureau of Science Education, which was conducting the study. During 1979, interviews were conducted with experts in five museums containing some of the largest fossil collections in the world. These experts were: Colin Patterson (Paleontologist, British Museum of Natural History); Niles Eldridge (Invertebrate Paleontologist, American Museum of Natural History); David Raup (Curator of Geology, Field Museum of Natural History); Donald D. Fisher (State Paleontologist, New York State Education Department); and David Pilbeam (Curator of Peabody Museum of Natural History). During the interviews, the paleontologists were questioned about the nature of the fossil record from the Pre-Cambrian to recent time. All of these scientists believe that all living and fossil organisms were derived from a common ancestor in an unbroken evolutionary lineage. None of them believes in the creation theory that functionally complete original organisms were created and placed upon the earth by an intelligence or power external to the universe. (JN)

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DARWIN'S ENIGMA: THE FOSSIL RECORD

Interviews with Five Natural History Museum Officials

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Darwin's Enigma: The Fossil Record © 1981

by

L.D. Sunderland

There is a widespread escalating interest today in the subject of origins, not only how the human race originated but how all life, the earth and universe came into existence. Mankind has always been concerned about where things came from, but interest has never been higher than it is today.

With the mind-boggling advancement explosion in science and technology, solutions have been found for numerous problems and puzzles which for ages troubled the human race. Where complete solutions have not been accomplished, much progress has at least been realized. Secrets of the atom have been unlocked and harnessed, transportation and communication to anywhere have been made readily available to the public, the solar system has been explored, serious war has been avoided, some of the complex mysteries of the living cell unravelled and some cures for diseases like cancer developed. But with each step of progress in all these areas of human endeavor, the search for a scientific explanation for the origin of things has consistently and paradoxically been producing more questions than answers.

Hundreds of scientists who once taught their university students that everything had finally been figured out are today confessing they were completely wrong and their previous conclusions once held so fervently were based on very fragile evidence which has since been demolished. One of the most highly respected philosophers of science in the world, Dr. Karl Popper, is arguing that one theory of origins almost universally accepted by the scientific community as a scientific fact does not even qualify as a scientific theory. A new display at the famous British Museum of Natural History makes the same admission.

Outer space was once believed to hold the key to unlocking the mystery of origins, but explorations of the moon, Mars, Venus, Jupiter and Saturn emphatically brought these hopes down with a resounding crash. Whereas prominent scientists once were making bold assertions that the evolution of life was not only probable but inevitable on other solar system planetary bodies and the study of that life would help solve the mystery of the origin of terrestrial life, now they are throwing up their hands in futility convinced there is no hope of ever finding extra-terrestrial life in the solar system.

When Watson and Crick discovered the DNA molecule and deciphered the way it codes amino acids of the cell and replicates itself, there were great expectations that a plausible scientific explanation for the origin of life was just over the horizon. The synthesis of amino acids in the laboratory from basic chemicals further heightened the expectations that man with all his intelligence and resources could synthesize a living cell. These hopes have also been dashed with failures to generate life in a laboratory and researchers are stating that new natural laws will need to be discovered to explain how the high degree of order and specificity of even a single cell could be generated by random natural processes.

Geology and paleontology held great expectations for Charles Darwin who admitted they were the strongest single evidence against his theory in 1859, but he held to the strong faith that future explorations would reverse the situation and prove his theory correct. He stated in his book, The Origin of Species, "The geological record is extremely imperfect and this fact will to a large extent explain why we do not find intermediate varieties, connecting together all the

extinct and existing forms of life by the finest graduated steps. He who rejects these views on the nature of the geological record, will rightly reject my whole theory."

Now after over 120 years of the most extensive and painstaking geological exploration of every continent and ocean bottom, the picture is infinitely more vivid and complete than it was in 1859. Formations have been discovered containing hundreds of billions of fossils and our museums have cataloged over 250,000 different species. With every formation explored and every fossil cataloged, it has become more apparent that these, the only direct scientific evidences of the history of life, do not provide any evidence for which Darwin so fervently longed. The gaps between major groups of organisms have been growing even wider and more undeniable. They can no longer be ignored or rationalized away with appeals to the imperfection of the fossil record.

By 1979, prominent scientists in the world's greatest fossil museums were coming to grips with the so-called "gaps" in the fossil record and were beginning to cautiously throw out new theories of evolution for discussion which might explain the severe conflicts between neo-Darwinian theory and the hard facts of paleontology. Actually, Dr. Richard B. Goldschmidt, famous geneticist of Berkeley, California, was the first to face the horns of this dilemma with this 1940 book The Material Basis of Evolution. He said that we had dug nearly a hundred years since Darwin and hadn't filled the gaps so he advanced his theory of Hopeful Monsters to bridge the gaps.

This is the idea that every once in awhile an offspring is produced that is a monster grossly different than its parents, like a two-legged sheep or a two-headed turtle. These are all deleterious monsters which cannot survive, but, hopefully, if you got enough of them you might get a good one. For instance, to explain the gap between reptiles and birds he endorsed the idea that one day a reptile laid an egg and a bird was hatched from the egg.

Goldschmidt's revolutionary evolutionary ideas were laughed at for many years, but by 1977, prestigious scientific periodicals like the American Museum's Natural History magazine were publishing articles predicting the vindication of Goldschmidt's theory within a decade. Dr. Eldredge, curator of invertebrate paleontology at the American Museum was agreeing with Dr. Gould of Harvard and calling his new theory Punctuated Equilibria.

Dr. David Raup, curator of geology at the Field Museum of Natural History in Chicago published in that museum's journal an article entitled, "Conflicts Between Darwinism and Paleontology" in which he stated that the 250,000 species of plants and animals recorded and deposited in museums throughout the world did not support the gradual unfolding hoped for by Darwin. Dr. Colin Patterson wrote in a letter to the author in April 1979 that he didn't know of any evolutionary transitions either living or fossil.

Dr. Pilbeam, curator of the Peabody Museum of Natural History at Yale wrote in 1978 in an article entitled, "Rearranging Our Family Tree" that he was convinced we would not hit on the true or correct story of human evolution.

By the late 1970's, debates on university campuses throughout the free world on the subject of origins were being held with increasing frequency. Hundreds of scientists who once accepted the theory of evolution as fact were abandoning ship and claiming the scientific evidence was in total support of the theory of creation.

In December of 1978, the New York State Board of Regents ordered the New York State Education Department to conduct a detailed study of the way in which the subject of origins should be treated in a revised version of the Regents Biology Syllabus. The author was invited to supply scientific information to the Bureau of Science Education conducting this study.

During the next year he conducted taped interviews with experts in five museums which contained some of the largest fossil collections in the world. Written transcripts of these interviews were given to the New York State Education Department for use in their study on origins.

In these interviews, the paleontologists were questioned about the nature of the fossil record from the Pre-Cambrian all the way up to the recent. Typed transcripts of the five interviews were sent to the interviewees for editing. All but one, Dr. Patterson's, were returned with corrections which were made to the master copies.

Manuscripts of these interviews are reproduced in the following pages of this book for study by all those who are interested in discovering the nature of the fossil record as seen through the eyes of five distinguished paleontologists. All of these scientists believe that all living and fossil organisms were derived from a common ancestor in an unbroken evolutionary lineage. None of them believes in the creation theory that functionally complete original organisms were created and placed upon the earth by an intelligence or power external to the universe.

The reader might wish to read other books that also discuss the nature of the scientific evidence relating to origins. The following books are only a few which are recommended:

1. Ager, Derek. The Nature of the Stratigraphical Record. The Macmillan Press Ltd. 1973.
2. Bliss, Richard; Parker, Gary; Gish, Duane. Fossils: Key to the Present. CLP Publishers, P.O. Box 15666, San Diego, CA 92115.
3. Bliss, Richard. Origin of Life. San Diego: CLP Publishers.
4. Bliss, Richard. Origins: Two Models. San Diego: CLP Publishers
5. Kerkut, G.A. Implications of Evolution. New York: Pergamon Press, 1960.
6. MacBeth, Norman. Darwin Retried. Boston: Gambit Inc. 1971.
7. Wysong, R.L. The Creation/Evolution Controversy. Inquiry Press, 4925 Jefferson Avenue, Midland, MI 48640.

June 30, 1979

INTERVIEW WITH DR. COLIN PATTERSON
PALEONTOLOGIST AT BRITISH MUSEUM OF NATURAL HISTORY

BY

LUTHER D. SUNDERLAND

On June 15, 1979, Dr. Patterson was given two books to read, Evolution? The Fossils Say No! by Duane Gish and The Creation-Evolution Controversy by R. L. Wysong. At the time of the following interview with L. D. Sunderland, Dr. Patterson had read about half of Dr. Gish's book, the first two chapters and other portions of Dr. Wysong's.

1. Dr. Patterson, what do you know about Pre-Cambrian fossils?

Ans. - Before the Ediacarian formation, I know of no fossils. The fossils found there are protozoa, bacteria, etc. all single celled organisms. Much work has been done on that in the last seven or eight years. Of course, there is argument about some of them, particularly the earliest ones, that these aren't fossils at all, that they are inorganic things. Perhaps it is correct that they are inorganic. But by the time you get to 1200 million years, and they are scattered, you've got things that I think no one could deny are fossils of single celled organisms.

2. Do you agree with Dr. Preston Cloud that not a single, unquestioned, multi-celled fossil has been found in Pre-Cambrian rock? (Gish pp. 62, 63)

Ans. - Yes, I do if we take the Ediacarian as very late Pre-Cambrian.

3. One claim in Dr. Wysong's book The Creation-Evolution Controversy is that fossils are often found in rocks completely out of order by hundreds of millions of years and the overthrust explanation is given to account for this although there may be no sign of overthrust. Do you know anything about this?

Ans. - This is certainly not true in my field (fish paleontology). Of the things I know about fishes, no one has ever tried to say that these were in the wrong places and overthrust.

4. In Glacier National Park, for instance, there are hundreds of square miles of Pre-Cambrian rock thousands of feet thick sitting on top 500 million year younger Cretaceous rock. The museum there claims this is explained by the Lewis Overthrust. They cannot display any sign of rock flour formed by rock movement at the contact line. Yet there is supposed to have been miles of rock movement.

PATTERSON INTERVIEW (Cont'd)

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4. Ans. - I don't know anything about this. I haven't got that far (in the book). I have read only the first thirty or so pages and there was nothing there that I would disagree with. Then I went on to the part about fossils.

5. Then you haven't found any errors yet?

Ans. - Oh, I have found some errors. I could talk about Archaeopteryx. I don't know what he means by "absence of teeth" since Archaeopteryx had teeth. I wouldn't argue with it otherwise, I agree that it has simply become a patsy for wishful thinking. I agree with him entirely.

Reply - Archaeopteryx had teeth but he points out that some reptiles like turtles have no teeth.

6. What about the horse series?

Ans. - I agree with him again.

7. I'm personally not too convinced about that being a series at all.

Ans. - I'm not either.

8. Have you seen the recent issue (Volume 60, #22, May 29, 1978 p. 474) of Transcript of American Geophysical Union in which Dr. Gentry commented about a conference he held on radiometric dating? Some very serious questions were raised about the assumptions on which radiometric dating is based.

Ans. - No, I have not seen it, but I shall read it.

9. How do you explain the so-called Cambrian explosion, this sudden appearance of multi-celled creatures - all major phyla in the animal kingdom? I've seen that quoted many times.

Ans. - Well, it's not true that it's all major phyla. Vertebrates are missing. I agree completely with the chart on page 180 of Wysong.

10. Didn't you see that article (Science, Volume 200, May 5, 1978) reporting fish in the Upper Cambrian of North America?

Ans. - Yes, we discussed it, but I don't agree that they found vertebrate fish.

PATTERSON INTERVIEW (CONT'D)

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11. But vertebrates are a subphylum and chordates have been found (in Cambrian).

Ans. - Well, we could argue about the classification system. What are the chordates?

12. Do paleontologists really name the same creature different species names when it is found in rocks of different geologic periods?

Ans. - Oh yes, that's very widely done.

13. That doesn't seem quite honest. You wouldn't do that would you?

Ans. - I hope I wouldn't.

14. You stated in your letter that there are no transitions. Do you know of any good ones?

Ans. - No, I don't, not that I would try to support. No.

15. Do you know of any alternatives to gradualism?

Ans. - I know of only one. Gould and Eldredge call it "punctuated equilibrium".

16. You don't sympathize with that hopeful monster idea do you?

Ans. - Well, it seems to me that they have accepted that the fossil record doesn't give them the support they would value so they searched around to find another model and found one. The support they get for that model comes from geneticists and population biologists who have trouble imagining how a large population could split. So they say it doesn't have to happen that way. A population was isolated by a catastrophe of some sort. Once you start applying that reasoning to the fossil record, you are doing what these people (creationists) are saying you are doing. When you haven't got the evidence, you make up a story that will fit the lack of evidence.

17. Some people ask, couldn't there be a third model besides the creation and evolution models - like Von Daniken's contention that everything was dumped out of a bunch of spaceships?

PATTERSON INTERVIEW (Cont'd)

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17. Ans. - Well, as Wysong says, that just puts the problem somewhere else. Life had to start somewhere. If it didn't start here you can say that it came by a fleet of rocketships but that doesn't answer the question. I agree with what this man says about that.

18. Wysong and Gish make quite an issue about all mutations being deleterious. Do you know of any beneficial mutations?

Ans. - First of all, how you classify a mutation depends upon how you look at it and the scale in which you look at it. He gives several cases where mutations, such as sickle-cell anemia, are harmful. He says it is of local advantage because of the malaria resistance but it is disadvantageous everywhere else. To that extent it is not absolutely disadvantageous. The way we got penicillin was by irradiating mold. To get a thousand fold increase in the amount of penicillin is an advantage. Under these circumstances, those are obviously good mutations.

19. In the delivery rooms of hospitals even evolutionists don't hope for a mutation, yet, they say we got here by gradual mutations.

Ans. - Right.

20. So, you don't know of any advantageous mutations?

Ans. - I didn't say I didn't know of any advantageous ones, I have already mentioned two, penicillin and sickle-cell anemia.

21. But, to the overall population, you agree that sickle-cell anemia is deleterious? It might be locally advantageous.

Ans. - Well, that is all anyone can say. Nobody would ever say that all these mutations would be advantageous.

22. Dobzhansky, after years of irradiating fruit flies for thousands of generations to artificially induce mutations, couldn't think of a single mutant that was more viable out in nature. He could only think of several which might be more viable at unusual conditions like very elevated temperatures.

Ans. - Yes. His fruit flies were all in glass jars.

PATTERSON INTERVIEW (Cont'd)

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23. What do you think the mechanism is for evolution if it ever actually occurred?

Ans. - I have to agree (with Dr. Wysong and Dr. Gish) that the only known kind of mutation is spontaneous change.

24. It is claimed that organisms evolve or develop resistance to antibiotic drugs but some bacteria frozen in 1946 before antibiotics were developed were found to be immune to as many as six different antibiotic drugs. So the resistance was already in a small proportion of the population.

Ans. - Oh yes. If you take any bacteria population numbering in the thousands of millions, then for a given mutation, some will pop out.

Reply - The literature now says that the resistance is due to an extra-chromosomal material called plasmids, not mutations at all.

25. Wysong states that people can't even conceive of an evolutionary progression for plants and quotes several experts like Dr. Corner to back this up. Have you seen any?

Ans. - Yes. I've seen plenty published on the origin of plants. A volume came out a year or so ago on angiosperm flowering plants. Although I would agree that they are not convincing.

26. You said in your letter (to me) that your understanding of genetics seems to demand a belief in gradualism. How do you account for the origination of the DNA code in the first cell? How could that have just happened by accident?

Ans. - It couldn't. Absolutely, I agree.

Reply - Then you agree (with Gish and Wysong).

27. What about embryology? Some textbooks still use embryology as evidence for evolution. Do you feel comfortable with this?

Ans. - Yes, I do. It's one of the few things that I think has survived. The expectation in Darwin's time was that all we need do is look at fossils and they will give us the answers. But it's true to say they haven't. I do like the ideas of embryology and that's one of the few things that has stood the test of time.

PATTERSON INTERVIEW (Cont'd)

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28. But I see lots of things that make me wonder about it, like the gill slits in the human embryo. They are not slits and are never part of the respiratory system and they are not gills, so how can they be called gill slits?

Ans. - But that is quibbling about words. I wouldn't call them that. I call them visceral clefts. That is the technical name.

29. Why would that show any phylogenetic history if organs develop as much out of sequence as is claimed by competent embryologists today. (pointed out by Dr. Gish, p. 166). For instance, the tongue forms before the jaw. That's backwards.

Ans. - If you look into it, you find that what they are saying is that the tongue forms before the bones of the jaw. Now nobody would suggest that the bones of the jaw were there in history before the tongue.

30. Are you aware that the human embryo at no time is anthropoid in appearance but that the ape embryo appears humanoid at one point? That's backwards isn't it?

Ans. - It's only backwards if you insist that man is the highest point in the evolutionary tree, which I wouldn't try to say.

31. Then you say that although there isn't any evidence for evolution in your field, there is evidence in someone else's field?

Ans. - No, I certainly didn't say anything like there were no evidences.

32. What evidence is there in your field? You say there are no transitional forms?

Ans. - There are kinds of change in forms taken in isolation but there are none of these sequences that people like to build up.

33. In other words, there might be evidence of all dogs coming from a common ancestor or cats coming from a common ancestor, but you don't see the bridging of the gaps that would be needed for macro-evolution.

Ans. - Yes. But the evidence of all dogs coming from a common ancestor is no better than that all fishes come from a common ancestor. If you ask, "What is the evidence for continuity?" you would have to say, "There isn't any in the fossils of animals and man. The connection between them is in the mind."

PATTERSON INTERVIEW (Cont'd)

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34. But at least in living life forms, we know genetically how you can get all the dogs from a common ancestor because they are all interfertile.

Ans. - That is domestic dogs.

35. Yes, plus wolves, coyotes and jackals. They are all interfertile and have fertile offspring.

Ans. - How do we know that? A lot of the evidence is from anecdotes. I don't believe that anyone has done the work to find out what happens for example, if you breed a wolf and a coyote and see what happens after ten and a half generations.

36. I don't know what happens after ten and a half generations, but the first ones are interfertile.

Ans. - Yes.

37. You have already told me that you don't know the phylogenetic origin of fishes like the progression from a starfish to a fish or pelecypod or anything else. How do you see that evolution might explain the origin of fishes?

Ans. - (Pause)

38. Then you'd rather not say?

Ans. - Ten years ago I'd have been perfectly willing to tell you, but it so happens that I know someone who is working this problem for about 15 years - the starfish end of it - the echinoderms. He believes that this development can be traced from the Cambrian with the echinoderms. I could very easily refer you to his work and say that I agree with him that fish are related to echinoderms, but I do not think it is obvious.

39. What about amphibians? Are you any more comfortable about the lobefin fish turning into the amphibian?

Ans. - Well, I'm working on it now.

40. Do you think there is evidence of that happening?

Ans. - The evidence that it happened is that there are animals alive now and we can't tell whether they are fishes or amphibians. The lungfishes have bones in the pelvic area which make them a candidate.

41. Then you don't think the crossopterygian was the ancestor of the ichthyostegid amphibian?

PATTERSON INTERVIEW (Cont'd)

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41. Ans. - I have questions about that. But I'm not interested in ancestors. I'm interested in --

42. Research?

Ans. - In research. It is futile to be looking for answers to questions which we have no way of answering.

43. What do you think about the bone spurs in some snakes?

Ans. - You mean the rudiments of the hind legs? I think they are rudiments of the hind limbs.

44. Could they also be explained as useful to help the snake locomote?

Ans. - I say, I don't know.

45. I asked Dr. Gish about that and that is his explanation.

Ans. - Well, then it's up to him to find out what advantage they are just like the evolutionist must do.

46. Do you agree that neither evolution or creation qualifies as a scientific theory since they can't be tested?

Ans. - That's right. I liked Wysong's quote (L. T. More corroborating Huxley's comments, p. 31) that both ideas have to be accepted on faith. "The more one studies paleontology, the more certain one becomes that evolution is based on faith alone; exactly the same sort of faith which is necessary to have when one encounters the great mysteries of religion... The only alternative is the doctrine of special creation, which may be true, but is irrational." I agree.

47. Have you any idea where the first mammals might have come from? I shouldn't belabor this since you said there were no transitions, but I would be interested in your assessment of the claim that moles or hedgehogs were the first mammals.

Ans. - Some say that the first mammals appeared in the Triassic or argue about Jurassic or Cretaceous and make up sequences for placental mammals, marsupials, etc. consistent with the story of evolution.

PATTERSON INTERVIEW (Cont'd)

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48. Aren't marsupials a problem for evolution since marsupials and placentals branched off way down at the reptile stage and then developed nearly parallel lines with some animals like the Tasmanian wolf having bone structure nearly indistinguishable from North American wolf?

Ans. - They are by no means indistinguishable. One has placental bones and one has marsupial bones. They have comparable bone structures in that they have mammalian bones.

49. What is the biggest problem you see with the concept of evolution? Since we can't think of a third idea, then either creation or evolution must be true.

Ans. - It is a philosophical problem. People have been working in this area for a long time and they seem to find nothing but confirmation.

50. They find what they are looking for?

Ans. - Yes, I think so. I feel the same way.

51. Yes, but you seem to be trying to be open minded but you are finding things you are questioning and you are not dogmatic as some people in this field.

Ans. - Yes. When it comes to problems, within the things that I work on, I don't have any problems that I think are insoluble. Over the last few years, my approach to the problems have changed a lot. The problems haven't changed. I haven't solved them to my satisfaction and I wouldn't expect to your satisfaction.

52. Well, I'm trying to find out what really happened.

Ans. - I don't believe you ever will.

53. I don't like that answer. I'm too much of a scientist. I think there are solutions to the problems.

Ans. - There are solutions to problems in science but I don't think this is science we are talking about, I think it's history.

PATTERSON INTERVIEW (Cont'd)

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54. We at least can apply scientific principles. Maybe you can't carry it all the way to the end like in testing an electronic circuit to see if it works or not.

Ans. - Yes, you can test genetics like that.

55. That leads to a dead end alright - an absolute dead end. The origination of the DNA for the first cell cannot be shown by genetics to have spontaneously come about.

Ans. - But that is history.

56. Here is a copy of the radiocarbon report by Dr. Whitelaw I told you about.

Ans. - I can't comment on that until after I've read it.

57. I've added on a chart. To show that he wasn't playing any tricks with the raw data with his correction factor, I plotted the C-14 dates as published. They also show the same pattern with a huge discontinuity at 6,000 years before present.

Ans. - Your plot shows that something surely happened 6,000 years ago. Could it have anything to do with magnetic reversal? And I know nothing at all about physics.

Reply - I don't think C-14 decay rates can be altered significantly by a field as weak as the earth magnetic field.

58. What do you think of the Australopithecines as man's ancestors?

Ans. - There is no way of knowing whether they are the ancestors to anything or not.

59. What about the Hardy-Weinberg Law? It's often used in test-books to explain evolution.

Ans. - It is?

60. I think it shows stability myself.

Ans. - Yes. It has nothing to do with evolution. People keep asking me why I didn't mention it in my book. Ha! Ha! It has nothing to do with evolution. Everytime I find a population it's inside Hardy-Weinberg equilibrium.

PATTERSON INTERVIEW (Cont'd)

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61. Do you know of any cases where soil layers are found anywhere in the geologic column? I understand there is not one found from the Pre-Cambrian at the bottom of the Grand Canyon throughout the Cenozoic at the top of Bryce Canyon.

Ans. - I don't know about the Grand Canyon but, when I was a student, I collected samples of a clearly discernible soil layer in the Jurassic. There were upright tree trunks and soil that looked like any loose soil near the surface. There were about four of them. There was about 80 feet of limestone above the topmost soil layer along the sea cliff.

62. Do you know of any significant number of fossils being formed today?

Ans. - The only two cases I know about are some dead fish that were dredged up from the bottom of the Black Sea and off the coast of South Africa 500 feet below the surface of the water. There is no way of knowing why they are lying on the bottom or if there are significant numbers of them. Perhaps they floated to the surface and burst. They are not fossils yet.

63. But do you know of any quantities comparable to the tens of thousands found in the Lompoc formation of California?

Ans. - No, not like the Lompoc. These things are scattered and they are rare.

64. Do you know of any evolution going on today in the macro sense where we're looking for a new structure that previously did not exist? Like an arm forming.

Ans. - No, not of an arm forming. Not in the Macro sense.

65. What about something like an eye?

Ans. - How could we recognize it?

Reply - It would be pretty obvious to anyone if they saw an eye that was almost formed but couldn't see or an arm that couldn't function.

66. Then you know of no structure that you could classify as developing and is not fully functional?

Ans. - No.

PATTERSON INTERVIEW (Cont'd)

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67. Both Dr. Gish and Dr. Wysong say that there is no real evolution going on today other than minor variations like the shift in coloration in moths.

Ans. - I have to say I don't know of any either.

68. One final question, both authors, as far as I know, take the position that public school students should be exposed to all of the information on both sides of the subject of origins, not just one biased viewpoint. Do you think that is wise?

Ans. - No.

69. Why not?

Ans. - Where are you going to draw the line? How are you going to bring up a child telling him all the things we aren't sure about?

70. Oh yes. That is what I'm concerned about. I'm concerned that they are now being told a misleading story. I have many examples of what is being taught today. Much of it is totally incorrect.

Ans. - What about the history though of evolution?

Reply - I don't think you should perpetuate an incorrect concept when you have good evidence like is found in these books which shows that there is no scientific data supporting evolution and so much data supporting the creation model.

71. What would it harm a student to know these things?

Ans. - Because the time for education is when they are young. If you were to treat every subject this way and say that a child must be allowed to choose for itself - you must give it the facts and let the child choose the very first thing when you start speaking to it, why should you do that?

72. Why should you teach him something that is a totally false concept as though it were really true?

Ans. - There are some people I know who speak several languages. If you speak several languages to a child he doesn't learn to speak until later.

73. Would you advocate not teaching anything about origins? You know very well that what is being taught today is not correct.

Ans. - No, I don't know that it is not correct.

PATTERSON INTERVIEW (Cont'd)

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74. Well it is taught incorrectly in many of our schools. I can show you case after case where students are being told as though it were an historic fact that things evolved, that the transitional forms exist and the study of the plant and animal world shows that it really happened. Isn't this a total untruth, a lie by any standard?

Ans. - No, it isn't.

75. From the foregoing, it appears to me that it is, especially when information about the only competitive concept which the scientific evidence supports is withheld. What these people (Gish and Wysong) are saying is that all of the information should be presented to students openly rather than that aimed at supporting only one biased viewpoint. There is a movement in the United States, and elsewhere, to get this kind of information published. If you can find nothing wrong with it then why should students not be allowed to hear it?

Ans. - I can find plenty of things wrong with the information. The thing I agree with is the philosophy. I will certainly agree that the first thing you do is what was done in the Middle Ages: take students up through Plato, Aristotle, Socrates and Descartes, etc. to teach them philosophy and how to recognize truth when they find it. If there is no way of recognizing it, tell them that. From then on say, "All right, we don't have time to tell you all the facts so we'll give you our story. If you can pick holes in it, then by all means do."

76. According to our Supreme Court, in the United States there can be legally no "Our Story". The state cannot prescribe a philosophical belief system. The state does not dare take a position on religion or philosophy, and that is what we both agree a position on origins amounts to.

Ans. - We have an established church here in England. That sort of thing is permitted. Here religious education is compulsory. To me that's as much a pack of lies as any of these things.

77. What I am interested in doing is checking out the material in these books to see if it is correct. If it isn't then we shouldn't allow it to be presented in schools.

Ans. - From what I've read of it so far (Wysong) it is a good book. The facts that I would say are mistakes are just small things that are obvious.

PATTERSON INTERVIEW (Cont'd)

77. Reply - Thank you. I appreciate this interview very much, Dr. Patterson. The information you have supplied and your assessment of these two books will be taken into consideration by those reevaluating the teaching of origins in the United States, in particular in the state of New York.



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Telephone C1-589 6323 ext

Department of Palaeontology

Luther D Sunderland,
5 Griffin Drive,
Apalachin, NY 13732
USA

Your reference

Our reference

Date 10th April 1979

Dear Mr Sunderland,

Thanks for your letter of 5th March, and your kind words about the Museum and my book. I held off answering you for a couple of weeks, in case the artwork you mention in your letter should turn up, but it hasn't.

I fully agree with your comments on the lack of direct illustration of evolutionary transitions in my book. If I knew of any, fossil or living, I would certainly have included them. You suggest that an artist should be asked to visualise such transformations, but where would he get the information from? I could not, honestly, provide it, and if I were to leave it to artistic licence, would that not mislead the reader?

I wrote the text of my book four years ago. If I were to write it now, I think the book would be rather different. Gradualism is a concept I believe in, not just because of Darwin's authority, but because my understanding of genetics seems to demand it. Yet Gould and the American Museum people are hard to contradict when they say that there are no transitional fossils. As a palaeontologist myself, I am much occupied with the philosophical problems of identifying ancestral forms in the fossil record. You say that I should at least 'show a photo of the fossil from which each type organism was derived.' I will lay it on the line - there is not one such fossil for which one could make a watertight argument. The reason is that statements about ancestry and descent are not applicable in the fossil record. Is Archaeopteryx the ancestor of all birds? Perhaps yes, perhaps no: there is no way of answering the question. It is easy enough to make up stories of how one form gave rise to another, and to find reasons why the stages should be favoured by natural selection. But such stories are not part of science, for there is no way of putting them to the test.

So, much as I should like to oblige you by jumping to the defence of gradualism, and fleshing out the transitions between the major types of animals and plants, I find myself a bit short of the intellectual justification necessary for the job.

Thanks again for writing.

Yours sincerely,

Colin Patterson

July 17, 1979

INTERVIEW: DR. NILES ELDREDGE
INVERTEBRATE PALEONTOLOGIST AT AMERICAN MUSEUM OF NATURAL HISTORY

WITH

LUTHER D. SUNDERLAND

1. Dr. Eldredge, I have read newspaper reports of some of the papers you have given which indicate that you seem to take issue with Neo-Darwinism as it is popularly taught. What is your Punctuated Equilibrium or Hopeful Monster concept?

Ans. - I tend to look at the world of evolutionary biology now as being divided up into two camps. The predominant one is the people who view evolution as basically the process of adaptations, morphologies - transformation of phenotypes. It is what the Neo-Darwinian point of view seeks to explain and I think explains it better than any other set of paradigms.

Well, Hopeful Monsters is kind of an interesting thing. It was invented by a geneticist (Dr. Richard B. Goldschmidt of Berkeley in 1940) to explain the sudden appearance of a new phenotype from the standpoint of the development of that phenotype from the other line of genotypes. So, from what I can see, the theory departs from Neo-Darwinism markedly. But it is from the same point of view. How do we explain the diversity of morphology that we see and the underlying genetic diversity? But there is another way of looking at evolution and I think that is the major implication, the one that is really going to last, about punctuated equilibrium.

It takes a different point of view. It asks, "What are the ancestors and descendants of evolution?" The answer to the question, of course, to this point of view is, species change, not genes and not anatomical configurations etc. These do change, but we also have ancestors and descendants and these are species. Species are real entities; they are reproductive communities that are discrete in space and time. They may or may not give rise to descendant species.

One of the big problems you have is to integrate the facts. We have a theory of speciation as you well know. In fact, it is a conflicting theory but it seems to be not very well integrated with the other body of evolutionary theory which is all addressed to how genes change and their products - their phenotypes - change.

2. We are going back much deeper than that. As you know, there are different concepts of origins, all the way from fiat creation to Darwinian evolution and punctuated equilibrium.

Ans. - Right.

3. We are going to try to step back and ask, "What is science? How do you get from your first hypothesis to a scientific theory - one that is somewhat substantiated and tested?" There are textbooks which take different viewpoints and we are trying to check out the accuracy of their contents.

3. (Cont'd)

I have one with me, The Creation-Evolution Controversy by Dr. Wysong which I would like for you to read. Perhaps I can come down and discuss it with you at a later date.

Ans. - Thank you very much.

4. I have a list of questions for you mainly on paleontology, basically the same questions I asked Dr. Patterson. What do you know about Pre-Cambrian fossils? What do we find in Pre-Cambrian rocks?

Ans. - Well, there are prokaryotic - apparently unicellular - organisms in rocks that are dated as old as 3.4 billion years.

5. Those are located where?

Ans. - Here is a piece of it from Rhodesia.

6. How about Greenland?

Ans. - No, the oldest rocks in the crust are from Greenland dated at 3.8 billion years.

7. Dated by which technique?

Ans. - Dated by thorium-lead or uranium-lead isotopes. Now these are (i.e. Rhodesian samples) dated in that fashion because you can't date a limestone which is what this rock is. You date it by its association with rocks that are dated that old radiogenically. This is filamented blue-green algae and apparently, histologically it differs very little from the simple prokaryotes. So I think that is fairly secure. The interesting thing about that is that the oldest evidence for life is almost as old as the oldest evidence for the actual age of the crust. Of course, the age of the crust is reliably, I think, estimated to be 4.5 billion years but the fact that life occurs in rock almost as old as the oldest known vestiges of the crust is interesting. It suggests that life is very much an essential component of this planet.

8. Are you aware of articles like this one by Dr. Preston Cloud from Geology magazine entitled, "Pseudofossils: A Plea for Caution"? There has been some contention about whether many of the Pre-Cambrian fossils are really fossils of unicelled organisms or just inorganic things which appear like fossils.

Ans. - Yes.

9. For instance, a NASA scientist studying what the earliest stages of life should look like claims to have simulated in the laboratory the appearance of these microscopic specs claimed to be fossils of unicelled organisms.

9. Ans. - Well, you see, what you have here (in this rock) is -- you get a fossil record of them from this time to the recent. What they are is sediment grains trapped in a fashion. Now, there is no way to really simulate that. This is a stromatolite. A stromatolite is an algal mass.

10. Can you see algae in this rock?

Ans. - Yes, well the experiment - these laminations that you get - they grow in formations today in Australia.

11. You say that rocks are forming today?

Ans. - These are stromatolites - the big cabbage head type things you see. They are mostly sediments trapped by the filaments of the algae. It is basically an inorganic structure but it wouldn't be there if it weren't held by the blue-green algae. Yes, the dispute about the organic nature of some of these - they are very simple forms, but I think some of the evidence is so compelling I see very little reason to question them. We should always be cautious, and I have a great deal of respect for Preston Cloud of course.

12. Do you agree with him that not a single indisputable multicelled fossil has ever been found in Pre-Cambrian rocks?

Ans. - Well, Preston Cloud defines Pre-Cambrian rock differently from some other people. I agree with him with the exception of the Ediacarian forms. He would define that as being above the Pre-Cambrian so it is a question of classification. He went on record ten years ago as extending the Cambrian down to include all multicellular organisms. I would agree with him there are no multicelled organisms until the very end of what is conventionally called the end of the Pre-Cambrian.

13. I see Dr. Axlerod agrees with him in this article from the July 1958 issue of Science, "One of the major unsolved problems of geology and evolution is the occurrence of diversified, multicelled marine invertebrates in Lower Cambrian rocks on all the continents and their absence in rocks of greater age."

Ans. - Well, this is a horribly out of date article. I wouldn't even consider it too much. There has been a lot of work done particularly in Siberia in the early Cambrian. What we are really talking about is the definition of the base of the Cambrian. Is there any multicellular, real unquestionable multicellular life lower than the first appearance of trilobites? That is traditionally considered to be the base of the Cambrian. We are talking about the classification of rocks here more than anything else.

There still is a tremendous problem there in the sudden diversification of multicellular life. There is no question about that. That's a real phenomenon.

ELDRIDGE INTERVIEW (Cont'd)

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14. What is your explanation of the so-called Cambrian explosion? How do you explain it on the basis of evolution?

Ans. - Well, evolutionary theory doesn't really enter in.

15. It certainly does. If you have all major phyla in the Cambrian just suddenly with no ancestors, how is that explained by either gradualism or punctuated equilibrium?

Ans. - Well, rapid diversification. Are you familiar with a paper by Stanley on ecological aspects of this thing? Well, I'm not going to give you a scenario of why I think that explosion took place. I don't work in problems of that kind.

16. Let me try on some explanations teachers often give to their students. You don't find ancestors of the Cambrian fossils because the rocks were all metamorphosed or eroded away.

Ans. - Certainly that has been refuted. I think the pattern is real. What we see there is not a function of the rotten record - it's a real biological problem. It's just that I'm kinda loathe to make up stories about it. We have a real problem here with testability.

17. Dr. Simpson said this is the major unsolved problem of the history of life.

Ans. - I wouldn't say it is an evolutionary problem. It doesn't — I would be willing to bet a very general principle, that that kind of pattern could be predicted from certain sub sets of existing evolutionary theory.

18. Such as?

Ans. - Well this is the punctuated equilibrium approach - that species will appear (rapidly).

19. Now, I've heard (Dr. Goldschmidt wrote) of a reptile laying an egg and a bird hatching from the egg, but I never heard of a single cell laying an egg and a trilobite hatching. A jump of that size, how would you explain it?

Ans. - Well, you are putting it in a morphological way now. I don't address problems from that point of view. And I won't speculate.

20. Do paleontologists name some creatures different names when they are found in different geological periods?

Ans. - Oh yes, people make mistakes.

21. No, purposely.

Ans. - No, certainly.

ELDERIDGE INTERVIEW (Cont'd)

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22. I asked Dr. Patterson the same question and he said, "Oh yes, that's very widely done."

Ans. - Well, I disagree with him.

23. How do you think the origin of vertebrates came about?

Ans. - I have no knowledge about that. The origin of vertebrates? From invertebrates?

Reply - Wherever they came from.

Ans. - I think that comparative biology shows that they are derivatives - that they are related. It relates them with echinoderms.

24. I wanted to ask you about echinoderms. Do you really think that a starfish turned into a fish?

Ans. - Of course not.

25. How about the fish to amphibian transition?

Ans. - That I know nothing about.

26. Do you have any feeling about the amphibian to reptile or reptile to bird transition?

Ans. - If you asked that question of Dr. Patterson, I'd predict that he would have said there is no such thing as a reptile. And in respect to amphibians, some biologists say there is no such thing as an amphibian either.

27. What do you call them?

Ans. - Well the reptiles are not a natural group because some are more closely related to birds and some are more closely related to mammals.

28. Closely related to birds in what way?

Ans. They share similarities with birds and therefore they must share some sort of a genealogical relationship with the birds.

29. But birds start at the feather line. Aves are classified as creatures with feathers.

Ans. - Yes feathers are a neat evolutionary novelty. The only things you have to work on are inventions. It's like tracing the history of manuscripts. Somebody makes a mistake in copying manuscripts. And

29. Cont'd

then the mistake is perpetuated. It gives you insight into the historical lineage of that manuscript. The same thing is true with evolutionary inventions. If you invent feathers, the supposition would be (which could be falsified) you'd see feathers and see the distribution of feathers and you'd guess that all of the things that have feathers are related. Now that could be wrong. It's open to questioning but it seems to be supported by a whole host of other things that unite birds.

30. Do you consider Archaeopteryx a transitional form?

Ans. - Again, I'm no expert in vertebrate anatomy but it seems to be a creature that has some of the advanced characters of birds and a tremendous amount of retentions of primitive characters, like it has teeth.

31. Isn't that true of every subclass of vertebrates, some have teeth and some do not. So how could that show reptilian ancestry. Some fish have teeth and some don't, some amphibians have teeth and some don't. Other ancient birds had teeth, and some mammals have teeth and some don't. How could you classify teeth as reptilian?

Ans. - I didn't. I said it is primitive.

32. How is it primitive? The presence of teeth seems to be a general characteristic of animals.

Ans. - In parlance of comparative biology, "relatively more general" is a synonym of "relatively more primitive". If some group lose teeth, for instance, people in old age, that's not an evolutionary advancement, but if some non-bird species doesn't have any teeth, like fish, then that's an evolutionary advancement for them. The general condition seems to be the presence of teeth is primitive for vertebrate organisms with heads and jaws.

33. How about man. Does the presence of teeth show him as primitive?

Ans. - Sure.

34. My point is, if in all subclasses of vertebrates, some have teeth and some don't, how could this show that Archaeopteryx is transitional with reptiles?

Ans. - I understand the argumentative nature of your question. It seems kind of strange. You are misconstruing my answer. I'm saying that Archaeopteryx is an amalgam of advanced (birdlike) characters and characters that are not birdlike. What are they? They are more generally distributed characteristics like the presence of teeth. I don't know. Details of its feet.

35. Children have been taught in school that Archaeopteryx was transitional because it had teeth.

Ans. - One of the things reptilelike was the feet.

ELDRIDGE INTERVIEW (Cont'd)

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36. We don't want to put that sort of speculation in the textbooks if it proves nothing.

Ans. - No you don't. You want to say that it is a primitive holdover.

37. Are man's teeth a primitive holdover? Are fishes teeth a primitive holdover? They really don't say anything about reptilian ancestry.

Ans. - I know. They are general. They don't tell you anything about the specific relationship with mammals or any group.

38. The museum here says the first mammals were insectivores. Do you agree with that?

Ans. - I have no knowledge about that.

39. Do you know anything about where whales came from?

Ans. - Oh, no, not particularly.

40. Did you see the National Geographic article on that? What have you heard?

Ans. - The way you should put it is what are whales related to? They came out of some group of the archaic ungulates.

41. Listen to this account from the December 1976 National Geographic on how these hairy four legged mammals ventured out into water and became whales.

Ans. - I wrote a paper several years ago and pointed out that in scenarios you are only limited by your own imagination and the credulity of your audience. I could probably do a much better job than that that would seem more plausible, but it is still just a scenario, just a story. As science, it doesn't wash.

42. Do you know of any part of evolution that is not just a scenario?

Ans. - Well, you see, the thing about evolution —

43. That is Dr. Patterson's point. He says in this letter to me that it is easy enough to make up stories, but he knows of not a single transition. You've been quoted in the papers as saying something similar.

Ans. - Yes.

Why did you write to him?

43. Reply - Because the schools have been teaching some things that are misleading. When you dig into it you readily find this situation. Yet, teachers that I know of just present the whole thing as though it were a fact. We want to try to sort out the science from the fiction.

Ans. - That's why I have got to try to teach you something right now, when you ask, "Is there not a part of evolution that is not a scenario?" There are several things that people mean by evolution. I think they are compounding them and confounding them. There is evolutionary supposed history - the actual sequence of events that took place in evolution.

44. You mean in present life forms like moths?

Ans. - I'm talking about that boundary of human enquiry that deals with the history - the actual sequence of events that happened in evolution.

45. You mean viewing fossils?

Ans. - Or in comparing things that are alive today from an evolutionary point of view. All of your questions so far have referred to statements various people have made about what they think happened in evolutionary history. That's one aspect of evolutionary enquiry.

The other area is that body of theory which purports to explain how evolution occurred. Now, you've got to keep those things separate.

I think some of the stuff about the mechanisms can be scientifically treated. It's open to a hypothetical deductive approach, but there are some real problems. Now punctuated equilibria is addressed to that area of enquiry. When we talk about evolutionary history, we have an entirely different kettle of fish. What we have here is a pattern that we are trying to analyze. Some people have been fed up with precisely the same kind of thing that you seem to be focusing all your attention on which is to say there have been an awful lot of stories, some more imaginative than others written about what the nature of that history really is. I admit that an awful lot of that has gotten into the textbooks as though it were true.

For instance, the most famous example still on exhibit downstairs is the exhibit on horse evolution prepared perhaps 50 years ago. That has been presented as the literal truth in textbook after textbook. Now I think that that is lamentable, particularly when the people who propose these kinds of stories themselves may be aware of the speculative nature of some of the stuff. But by the time it filters down to the textbooks, we've got science as truth and we've got a problem.

My way of looking at this is that there are only two generally held views on why we have the diversity of life and why there is a pattern of resemblance amongst all living things: creation and evolution.

46. I hate to interrupt, but I'm always asked if there couldn't be a third.

Ans. - There was a third biological one, spontaneous generation and that has been abandoned, rightly or wrongly by biologists.

47. But that doesn't differ with evolution which requires spontaneous generation of the first cell.

Ans. - Ah, I don't know.

48. Obviously it is.

Ans. - Well it is in a sense and it isn't in another. There are currently in vogue two sets. Right?

Reply - Right. I agree with you absolutely.

Ans. I view both as more or less antithetical sets of assumptions that people bring to the world. The common problem is to try to explain the panoply of different kinds of organisms that we have. I see them as axiomatic in the sense that I don't see one set falsifiable in favor of the other. I've had discussions with creationists and I won't argue that point at all.

We have a body of axioms - the creationist has and the evolutionist has - for which I can't think of a crucial test.

You have to say that in evolution, all organisms are related and there is some sort of natural process that has caused them to be fragmented into different kinds. That would be a general comment about evolution.

Reply - It's nice to talk with someone who doesn't try to throw in a third one - theistic evolution - that says every time we need a change in the DNA code, God steps in. I don't find any serious scientific theory like that but most of the general public sorta thinks, "Well, both sides must be right."

Ans. - Yes. Non-the-less, I can't think of a set of any experiments which I might set up that would reject one theory in favor of the other.

49. We have to consider all the literature on this. There are some books like this one by Dr. Wyszong entitled, The Creation-Evolution Controversy. I'll give you a copy to review.

Ans. - May I say why I personally have adopted the set of assumptions that say there is a natural process which is creative? I find that if you adopt those assumptions, then you can make a set of predictions which allows you to go about investigating the history of life. I feel that if I adopted a set of creationist assumptions, as I understand them, I couldn't.

50. Let me give you what all scientific creationists I have heard of use as the general creation model. It says that the universe could not have generated itself according to known laws now in operation, therefore, the universe and all life in it - some original kinds, whatever they were, they can't be precisely defined, not the present species for sure - were created by some supernatural power external to the universe. Time is not mentioned in the general creation model although the specific Genesis account can be fitted into one or more time frames.

Ans. - They won't grant that the carnivore all had a common ancestor for instance.

51. Right. They usually say we don't know what the created kinds were, but fossils give a good indication of where to draw the line. They recognize that there is a certain amount of parallel change, just no vertical change necessary to originate new structures where there were none.

Ans. - The pattern in nature that I'm concerned to explain - and I think we have only these two paradigms to explain - is this nested set of resemblances amongst all living things. That is the problem - the master question of the history of life. There are two explanations of course. God had a plan or as you get away further from a common ancestor you get more and more modification so you get a nested set. It seems to me you must accept one or the other axiomatically. As a scientist, the latter appeals to me only because it allows me to make predictions, to go and study organisms, look at them and try to come to grips with these similarities. This is falsifiable. Where the problem of ancestors comes in - and there's a whole bunch of problems - some of them are epistemological, how do we know an ancestor logically? It turns out an ancestor is going to be a very sloppy animal. It has to be. It is going to have none of the specialist features that unites things. It's going to be generalized. It is a logical problem but also there are some real-world type chronological problems. These come directly from feelings about how the evolutionary process really works.

I've got problems with ancestors too. That's why when I work with the history of life, I'm with guys like Patterson. All we try to do is chart these nested sets of resemblances and come down with the least objectionable sort of a theory about how things are related to each other in a general sort of a way. No definite statements about who was ancestral to whom.

If you are working on the species level because that is where I believe the theory is fairly sound, we do have ancestors and descendants.

52. Isn't it more than just species?

Ans. - No, just among species, that's all.

53. Some people (like Simpson) say, maybe families.

Ans. - They are wrong. How can a family evolve? What we think we know about evolutionary mechanisms, it is natural selection working on natural variation within species, generational change, and the origin of new species from old - the origin of new reproductive communities budding off old ones. If you have a pattern like that you are going to produce new species perhaps. You take these lineages and classify things and get larger and larger groups but those groups don't have the same ecological existence that species do. So my position - and I think other people are adopting it - is that species are real units in nature. I mean to say that I agree with others who feel this way, not that I invented it.

The genera, families etc., even if they are smaller lineages, don't exist in the same sense as a species. They only evolve as their component species do. Therefore, the idea of a family being ancestral to another family is illogical. It never happens.

54. Somehow the family that dogs or cows are in had to arise. You think there are transitions at the species level, but do you know of any at a higher level connecting them up? That is really what it is all about when you get down to it. Where did even a vertebrate come from? That would be easy to recognize.

Ans. - Well let's take cats and dogs. The closest on a scientific basis that I would want to ever put it would be that you've got this family here and its closest relative is this family over here - for example, say the hyenas or some other group and the felidae. They are the closest relatives because these two things might share a set of similarities that aren't shared with any other group. Say, the hyenas are unique in one sense and the felidae are unique in another but they share other sets of things that are unique to the two groups together. You might find something that combines those features that is generalized and doesn't share the specialized features of either of those two things but has only the generalized characters that unites those two. Now you might suspect that you have the ancestor by this line of reasoning.

For instance consider *Australopithecus africanus*. The skull of that is very difficult to assess. I tried and tried when I was working with an anthropologist to find a specialized feature someplace on the anatomy of it that would have allowed me to say yes it shares the specialized resemblance with, say, *Australopithecus robustus*, as opposed to *Homo habilis* or something like the, well the skull of *Australopithecus africanus* as it is presently understood - and this could always be falsified with new information - it is so generalized it is hard to say where to put it. Now some people say, "Ah ha! It's an ancestor." I say I don't know if it's an ancestor or not. All I know is it's a very primitive hominid. There is no way to really come to grips with it logically.

55. What is your explanation of a mechanism for evolution? It is usually held to be natural selection working on random mutations.

Ans. - Well, that's the core of New-Darwinism. More organisms are produced than can survive, a non-random pattern of survival. I'm giving you not what I believe but my rendition of the core of it.

56. What is non-random survival? The randomness comes in the original mutation, in the raw material.

Ans. - The mutation is random only in that it would not be directed to help the individual. It is not unlimited in the kind of mutations possible. Then natural selection selects out the most harmonious gene combinations.

57. Supposedly this spectrum (of mutations) includes some beneficial ones. Do you know of any beneficial mutations?

Ans. - Well you see, that's not the point! The point is that amongst all the gene complexes that are produced in any generation, (I'm just giving you my understanding) you are going to get some that are more harmonious than others. Maybe you are, maybe you aren't. We all know of people who have syndromes who have less chance of surviving and reproducing.

58. With sickle-cell anemia for instance, people are more resistant to malaria but to the overall population it is not advantageous since more die of sickle-cell anemia.

Ans. - Apparently most mutations are harmful - that's the old story - because they foul up in the developmental process. They are mistakes in copying, that's what they are. I would have to accept as a general proposition that some of these mistakes in copying must have been improvements because things have changed.

59. If evolution is true, that is? If you are going to be scientific, from where I sit -

Ans. - Yes. Well I told you I have adopted a set of axioms. The single axiom is that I see two sets of ways of explaining the nested sets of patterns and resemblances in the world. I have adopted as an axiom just to see how far I could go with it the evolution one because I think you can make more predictions and more statements. That's all I've said. It's not a matter of true belief.

I understand that to be the core of the Neo-Darwinian paradigm or model, the theory. The mistake that we have today I think is that - the most powerful individuals in the sense of their dynamism of their personalities etc., in the last generation more or less have it that that's all she wrote. We've got the synthetic theory of evolution.

60. But if you read those peoples' writing, many of them weren't as dogmatic as the textbooks.

Ans. - They probably weren't.

61. Dr. Dobzhansky said he never knew of a mutation in his fruit flies that would have been beneficial out in nature. People say he proved beneficial mutations in fruit flies but he was hard pressed to find one or two which might be beneficial at unusual elevated temperatures.

61. (Cont'd) Ans. - That weren't lethal. People in America and the world oftenthink that scientists have a bunch of answers. It's a difficult thing. It's a view that is not good.
62. Have you seen this letter in the Proceedings of the American Geophysical Union on Polonium 218 halos by Dr. Gentry? It casts serious doubts on most radiometric isotopic dates.

Ans. - I would hope that any proposition in science including those of Einstein are falsifiable and testable.

To finish about evolutionary mechanisms, the problem about the Neo-Darwinian idea is not so much that it's wrong, although there are some real problems with falsifying some of the concepts in it. Natural selection is particularly hard to deal with unless you have highly controlled laboratory conditions. However, I'm willing to accept the basic pure statements there as a black box.

I think the problem is natural selection doesn't explain the diversity of life. So the idea of punctuated equilibria attempts to fill the gaps. What it really does is say there are differential rates on the origin of species and differential survival of those species. It is still very evolutionary but there are still arguments within the evolutionary camp about what the mechanisms are.

63. What do you think of the origin of the DNA code for the first cell? How could that have just happened by accident?

Ans. - I have no opinion on that. I have never said that it did.

64. I didn't say you did. I asked Dr. Patterson that question and I wanted to get your answer also. It bears very pertinently on the validity of evolution.

Ans. - Is the position of the committee that there should be equal time for creationism?

65. Since there are only two models, we are trying to evaluate, for instance, whether that book should be placed as a reference in schools. It is already in some schools now. It talks about all these things we are discussing.

Ans. - I would like to say on the tape that my feeling about that is that students always should be exposed to the fact that there are at least two and, as you said, perhaps more. At least in terms of modern intellectual life there are these two basic sets of assumptions about the nature of the living world.

66. You don't object to both being taught?

Ans. - I don't object. In fact, it should be done. I think that would be good. However, in a course in biology which deals with science, I think the science version should not be presented along side of some other thing which is not science.

67. Which version do you say is science?

Ans. - I say the basic evolutionary theory (fraught with error as it is. Just like chemistry is fraught with error. It is scientific and it is a science and if we are going to teach science and physiology and other aspects of biology, then when we come to explain the diversity of life, we do have a scientific theory here however imperfect it might be, and it is science. It could be improved, as I said.

For the record this is the area that should be taught in biology, not creationism. I do not wish to be construed as supporting the teaching of both! However, it would be entirely appropriate at the outset to point out that creationism is another whole way of explaining the diversity of life. I also wish, though, basically, that all science (I went to school in New York - in Westchester) would be taught in such a way that it was a normal human enquiry into the natural world as opposed to the man-made objects. The logic involved is no different from literary criticism when you come right down to it and there is nothing sacrosanct about science, there is nothing definite about it or definitive about it. I think all of America would benefit from it if they learned something along those lines.

But I'm not going to argue about how DNA sprang up or anything like that. Not at all.

68. You see, that enters into whether the evolution model is science or not.

Ans. - I say it is science. You say the evolution model again. Which aspect? That part which dwells on supposed histories or that part that develops statements about how evolution is supposedly to have occurred. I think you can argue on epistemological grounds that there is some bad science done in both areas.

69. I've never yet seen anyone who said you could test evolution theory. In all the debates and books, frankly I have not seen anyone defend evolution as a scientific theory. They say it can't be tested in the laboratory because it proceeds at too slow a rate over too long a time span.

Ans. - No you can't test natural selection or anything more than from one generation to another. In the fossil record, you are dealing with things that are not subject to that. Needless to say in the natural world it is hard to get that kind of data. So you can't get it from long dead organisms.

69. Ans. cont'd - However, you can reformulate. You can say that what is going on, what's important here, is mainly species selection patterns. In which case, natural selection is quite irrelevant. The black box that is going on within species isn't creating very much difference at all. The punctuated equilibrium thing is based on the supposedly empirical observation that over the greatest part of their history, which might be up to ten million years according to best estimates, species do not in fact show the kinds of change you might expect if all that was going on to create the diversity of life was natural selection.

70. What do you say about Hardy-Weinberg? It is used in the present New York Biology syllabus to explain evolution.

Ans. - Hardy-Weinberg shows that things are in equilibrium and then you need certain conditions to disrupt the equilibrium. You are always going to end up in a new equilibrium. In my mind Hardy-Weinberg and all of the other formulas on population genetics show how difficult a job it is to change a characteristic.

71. What in your ^{mind} is the most difficult problem for evolution theory?

Ans. - I have co-authored a new book entitled, Phylogenetic Patterns and the Evolutionary Process. It deals with both sides of evolution, how you reconstruct the history of life in a scientific manner and also, how you make statements about the evolutionary process again in a scientific manner.

Making both aspects of the study of evolution more scientific is the ace number one problem, probably. But there are also some nitty-gritty problems. There are a number of problems left untouched really on the actual history of life, not even again in terms of ancestors and descendants, but just sorting out what is most closely related to what. In terms of how the evolutionary process proceeds, there is this whole area of macro evolution. I think, it is explained by this new theory which emerges which is that macro evolution is not reducible to micro evolution. So I find that exciting too.

72. Perhaps after you have read this book by Wysong, you will have some more opinions on these matters. I would like for you to check the accuracy of the material in it.

I appreciate the time you have spent with this interview. Thank you very much.

Ans. - I notice something here on page 23 of Wysong quoting a vehement proponent of evolution. "Thank you for your kind invitation to participate in your seminar. The so-called Special Creation is not a topic fit for scientific analysis, since no evidence can either prove or disprove it, and discussing it as if it were such a topic can only be misleading. I must decline your invitation."

73. You say you agree with it.

Ans. - I agree with it because if you adopt axiomatically the tenets of special creation as I understand it, it basically says that it is not true that there is a mechanism which accounts for the similarities amongst all creatures which is a process called evolution.

Reply - Yes, I think you are right.

Ans. - I think that special creation is, as this quote states, not a topic of scientific analysis because there is not any process in special creation which I am aware of which makes predictions about the nature of the world based on its axioms.

Reply - Wysong takes the position that special creation also is not a scientific theory.

Ans. - I do agree with that.

Reply - Thank you very much Dr. Eldredge.

July 27, 1979

INTERVIEW: DR. DAVID RAUP
CURATOR OF GEOLOGY
FIELD MUSEUM OF NATURAL HISTORY, CHICAGO, ILLINOIS

WITH

LUTHER D. SUNDERLAND

Dr. Raup, I would like to ask you some of the same questions which I asked Dr. Patterson and Dr. Eldredge. These are questions on the subject of origins, primarily about the fossil record.

1. What do you know about Pre-Cambrian fossils and rocks? For instance, Dr. Preston Cloud has said that not an indisputable multicelled fossil has been found in Pre-Cambrian rock. Do you agree with that?

Ans. - I'm not sure Preston Cloud would now.

Reply - I believe he has, within the last several years, stood by that position in a debate with Dr. Gish in California.

Ans. - Well, much depends upon how you define the boundary between the Pre-Cambrian and Cambrian. This has gone through several phases. There was a time when people were identifying as multicellular life, a whole bunch of things which subsequently have been shown to be purely inorganic. For example, there is one classic case where ripple marked sand which had been mud cracked and the interference of these patterns produced some very strange wormlike things. I think the crest of the ripples got broken off by the mud cracking. These things have been described as Pre-Cambrian metazoans (multicelled) several times but it was clearly shown a long time ago that they are not fossils. This kind of thing is a pseudofossil.

2. I have here Dr. Cloud's article from Geology, November 1973 entitled, "Pseudofossils: A Plea for Caution", have you seen that? It shows pictures of many pseudofossils.

Ans. - No I haven't. For a long time, these were the only Pre-Cambrian fossils known, but one after the other they have been debunked. Then in the mid-fifties, Barghoorn and Tyler described the microfossils, algae - from the Gunflint cherts on the north shore of Lake Superior. These were dated at roughly 2 billion years old, by uranium-lead I assume. Potassium-argon (dating) was just getting started in the mid to late fifties and didn't become widely used until the mid sixties... These are stromatolites. These were the first microfossils about which there was a consensus of agreement.

Then in the mid to late fifties, a graduate student, Bill Schopf, did a thesis on bacteria and algae in the Bitter Springs Formation in Australia. Since that time the pseudofossils have dropped from sight

2.(cont.)

thanks to Cloud's and other people's debunking. Microfossils get back to about 3.4 billion years.

Also in the fifties, Glaesner described a fauna of impressions of metazoan fossils in the sandstone of extremely late Pre-Cambrian age called the Ediacaran of Australia. These were just beneath the Cambrian. You can call it 600 million years if you want to (compared to 570 million years for the start of the Cambrian). There is a complete consensus in the trade that these are the first multicelled fossils. Some of the same fauna have been found all over the world.

I was in Moscow last winter and saw their Ediacaran stuff from Northwestern Russia and it is magnificent. Some of the fossils are different but some are the same as in Australia. Russians are way ahead in the study of late Pre-Cambrian metazoans.

Now, the Russians are working with the Tomotian stage in which they get a lot of perfectly ordinary Paleozoic looking fossils which are clearly older than what has been traditionally called the bottom of the Cambrian. So this whole Cambrian - Pre-Cambrian boundary is in a state of flux. This is moving the fossil record back, but not very far to 600 or 620 million years.

3. What is the best metazoan fossil? What is it? Is it just streaks in limestone?

Ans. - No. Those are the stromatolites. They are presumably of biologic origin. Now, the whole argument about stromatolites - they were thought to be inorganic for a long time. Modern day stromatolites are well known. They were found in the Shark Bay in Australia and since in the Virgin Islands.

4. These are not hardened rocks. They are just sediments trapped by algae?

Ans. - That's right. There is, I think, very little doubt that what is seen in the Pre-Cambrian stromatolites is the same sort of thing as is formed by algal and bacterial stuff.

Paul Hoffman of the University of Montreal has written some excellent papers on dubiofossils, on this whole subject of stromatolites.
and

To summarize then, in the older Pre-Cambrian you have microfossils in stromatolites and in youngest Pre-Cambrian you have metazoan - the Ediacaran about 600 million years old.

5. What about the Cambrian? How do you characterize it? How do you explain this sudden so-called explosion of very complex life forms?

Ans. - Maybe the best thing is to refer you to a recent paper by Professor J. John Sepkoski of the University of Chicago. (Paleobiology, Volume 4, #3, summer 1978, page 223). He is working on what went on right at the boundary of the Cambrian, the Vendian.

6. I'd like to get your feeling. How do you explain the Cambrian explosion? I've heard that all major phyla, even chordates, subphylum vertebrates, are found there.

Ans. - In the Upper Cambrian perhaps. There is no question that the major invertebrate faunas come in with a rush.

7. How do you explain that on the basis of evolution theory?

Ans. - My own hunch is that evolution is capable of moving at a colossal rate. I think that the amount of time involved is reasonable. You can ask, "Why hasn't it moved at that rate since?" But I think what we may be dealing with here is the filling up of geographical - ecological space very quickly and reaching some sort of saturation.

8. But what happened that none of the ancestors of all these phyla left any fossils? How come they didn't leave any fossils on the way to becoming fully developed organisms?

Ans. - It happened too quickly and sampling is deficient.

9. If evolution is true, either you would have the big jumps like Gould and Eldredge are saying with the hopeful monster mechanism, or you would have the slow gradual progression. Now, it would seem that to get a starfish or paleocypod or trilobite from a single cell would require billions of in-between forms. Why don't we have them?

Ans. - I don't know. The sampling is very thin in those rocks. In the fossil record as a whole, we are seeing maybe, if we are lucky, one percent of the species of these groups preserved. Most species just never get preserved. So it may be a combination of very rapid evolution, very rapid radiation and lack of preservation.

10. You know what these authors say. Dr. G.G. Simpson says that two thirds of evolution is over by the time we get the first fossil and it's the major mystery in the history of life. The creationists say, "Of course, to an open minded person, that would say the creation model agrees with what you find in the Cambrian rocks on the face of it. You have to make up stories to fill in the gaps."

10.(cont.)

Ans. - Sure. Yes. It's a process of rationalization. No question about it.

Some years ago in a final exam in one of my courses, I asked the students to disprove the proposition that trilobites arrived on the earth in a basket from outer space and I had alot of fun with their squirming on this. It's difficult to disprove this.

11. Since you've brought it up, I asked the same question to the other two gentlemen. There are generally two accepted theories, concepts or models on how things got here, on origins, i.e. creation or evolution. What about a third? Have you ever heard of a third concept? Of course you've already mentioned Von Daniken's idea that everything was dumped out of a fleet of rocket ships. Most people invariably ask this question, "Couldn't there be a third?" and they bring up Von Daniken's idea. What is your answer?

Ans. - If there is a third, interplanetary or interstellar seeding is one that should be considered.

12. As is pointed out by Wysong and others, that doesn't really answer the question, that just moves it back one planet.

Ans. - True. True.

13. So it's out of the sphere of scientific investigation.

Ans. - Well, not entirely. One could look at the data to see if they are more compatible with that idea than any other.

Reply - Yes. I think the data is in 99% or more agreement with that. If you admit there are no transitional forms, and if everything is fully functional when we find them, for instance in this Cambrian explosion everything was fully functional (I haven't heard of anything that wasn't fully functional, an eyeball was an eyeball, a leg a leg etc.), if that is the case then it would certainly support the model that things were transported here from another planet. I don't find anyone seriously pushing that one.

14. Let me try on a couple of explanations that teachers often give for the Cambrian explosion. All the Pre-Cambrian rocks were metamorphised or eroded away and therefore you don't have any ancestors of the complex forms.

Ans. - This is the old idea of the Lapalian interval, that there is a hiatus in the record. That won't wash. The record is complete enough in enough areas over that boundary that we can't use that anymore.

14.(cont.)

Reply - Dr. Axelrod was saying the same thing in a paper (4 July 58, Science, Volume 128, #3314, "Early Cambrian Marine Fauna") way back in 1958.

15. This report of fish being found in Upper Cambrian, (Science, Volume 200, 5 May 78, "A Fish from Upper Cambrian NA") how do you accept that?

Ans. - Yes, I know the paper. This is out of my field, but the people I've talked to think it's OK.

As a matter of fact, that material was in this museum for awhile and should have been worked up here.

16. Where can I find a picture of the heterostraci fish found there?

Ans. - Here in this book which is the bible of vertebrate paleontology, (Vertebrate Paleontology by Romer, 3rd Edition).

Reply - Then they look like the pteraspis, but they don't have the bony plates. They have scales over their whole body.

17. So you say the experts in this museum now think that the heterostraci fish found in Upper Cambrian is legitimate?

Ans. - We don't have any fish people here at this museum, but the people I've talked to around the country seem to buy this. That was in Upper Cambrian wasn't it?

Reply - Yes, but he also mentions in this article that the genus Anatolepis of which the heterostraci are a member has been found to be extant on three continents in the late Cambrian and early Ordovician rocks (North America, Greenland and Spitzbergen).

18. Then how do you explain the origin of vertebrates? What is your candidate for a transitional form between invertebrates and vertebrates?

Ans. - I can't really say. Echinoderms have been a likely candidate for a long time.

19. Starfish?

Ans. - Not starfish per se but primitive echinoderms. Here we get back to putting question marks at the branch points. There is no direct documentation. There are some early echinoderms that look, superficially at least, like fish but they don't look anything like starfish.

20. In these books it is claimed that paleontologists name the same creature different species names when it is found in different period rocks. Is that true?

Ans. - Yes, this used to be very common.

21. Why was that?

Ans. - It was also done geographically. If a fossil was found in South America which was indistinguishable from one previously known in Europe, many taxonomists would give it a different name. This was partly due to some evolutionary model that they were using which made it, to them, very unlikely that a species could have lasted such a long time or covered such a wide geographic area.

22. Then this was knowingly done. It wasn't just an accident?

Ans. - No. It was done on the basis of ^{an} a priori theoretical model. Most of those have been cleaned out now.

23. Dr. Eldredge, who is younger than you, thought it was accidental and couldn't figure out why I should ask the question. Dr. Patterson knew of it.

Ans. - It used to be a very common practice.

24. It seems to make alot more species.

Ans. - Oh yes. Somebody has estimated that approximately 70% of the species described are later synonymized with existing species. As a general average, about 70% of the species described as new, shouldn't have been, either through ignorance or because of ground rules used by taxonomists which we have just talked about.

25. What ground rule do you use to name a new species?

Ans. - If you can't find it having been found before and you are satisfied in your judgement it is sufficiently different to have been reproductively isolated.

26. Then the best definition of how to classify a new species is just that in the judgement of a competent paleontologist, it should be.

Ans. - It's a cynical definition but about right. At the bottom line you are trying to determine if the organisms would have been reproductively separated had they been living together.

27. How many species have been identified in the plant and animal kingdoms, as fossils and living?

Ans. - About 250,000 species of fossils have been named. The usual estimates of living species are around 1.5 million.

28. How do you feel about the fish to amphibian transition? Did the crossopterygian lobe fin fish turn into the ichthyostegid amphibian?

Ans. - All I know is what I read about. I'm an invertebrate paleontologist.

29. What is your title, by the way? Aren't you the curator of paleontology?

Ans. - Technically, curator of geology and chairman of the Department of Geology. The Geology Department combines paleontology and geology. I'm a paleontologist but chairman of the Geology Department.

30. Textbooks often show sketches of the skull and forefin of the crossopterygian fish and skull and foreleg of the ichthyostegid amphibian pointing out similarities in skull patterns and suggest that the bones of the forefins are changing into leg bones. They usually omit the rear fins for they are loosely embedded in flesh and could not possibly support the weight of the body. Yet, they show pictures of fish crawling out and walking around on land to impress the students.

Ans. - This is in the area of very sophisticated comparative anatomy and I don't think I have any more training than you do in this area. I don't think it is fair for us or Dr. Gish to look at pictures in books and say whether they are credible or not credible.

31. Dr. Gish is saying that pictures and stories in textbooks about fish walking on land are not part of science.

Ans. - There are fish today which can walk.

Reply - No. They do not walk. They cannot support the weight of the body on their fins. The so-called walking catfish slithers along on its belly. It can stay out of water for awhile due to moisture on its gills. No fish, living or fossil, has ever walked according to Dr. Gish. Dr. Sam Kirkwood, in a debate with Dr. Gish at the University of Minnesota made the serious mistake of claiming that fish footprints had been found but he had to embarrassingly admit his error for they were simply fin imprints. No fish has been found with feet.

Ans. - Ha. Ha. Ha.

32. Do you know of any transitional fossils that you say indicate that one form gave rise to another?

Ans. - The answer to that question depends upon the taxonomic level.

33. For instance, the origin of a new structure. The higher taxa had to form somehow if they all came out of nothing and out of a single cell or common ancestor. You should find some in-between forms that would show a structure developing like an eye or fin.

Do you know of any cases which you could defend as a transitional form between the higher taxa?

Ans. - I don't know what you mean by higher taxa.

Reply - That's easy. A family for instance.

Ans. - OK. Technically, anything above the species is a higher taxon.

34. Do you know of any transitions, period?

Ans. - (Long pause.)

35. Transitions in the fossil record, that is? I don't mean slight variations in birds beaks or coloration in moths. I think I could make a good case for connecting up some living species like dogs, wolves, jackals and coyotes since they are all interfertile and produce fertile offspring. But, in the fossil record, do you see any transitions?

Ans. - (Long pause - 10 seconds. No answer.)

36. I'll ask you about the horse, for example. That's always used. In fact, Dr. Tompson, a paleontologist at the Geology Department at SUNY, Binghamton recently told me he had lots of transitional fossils and couldn't understand why people like Dr. Patterson would say there are none. I said, "Show me one." He pulled out a book and showed me the horse series. How do you feel about the horse series?

Ans. - Well, as more has been learned about the evolution of the horse, more separate lineages have been recognized and it's far more complicated than early work indicated. Now, you do find transitions on a small scale. Dr. Gingerich at Michigan has been working on some (in other mammals).

37. On horses?

Ans. - Well, not precisely horses. Transitions between species, or what may be called genera, I think that's fairly well documented.

Reply - Dogs, wolves, jackals and coyotes are all called different species and yet are interfertile so that is easy to document. Just go interbreed them. Right?

Ans. - Yes. There is a problem here that bothers me. I certainly agree with Patterson that the large question of the origin of a dozen to twenty big groups - that it's very tough to determine the relationship of those.

38. Now, this is no incidental question. We are talking about separating science from conjecture in the classroom. We want to put science in and not conjecture. If you don't have any transitions you are willing to defend, that should be put into the textbooks.

Ans. - The question isn't quite that simple. Another question is that our taxonomy, by its very nature, does not allow for transitions - by the rules of nomenclature.

Reply - We'll change the rules. You show me an arm or fin or eyeball coming into existence.

Ans. - Hear me out. The books that we have been reading show many range charts and show that there is a line through time which represents an order and phylum and at another time an order and phylum and no intermediates. Now, what would an intermediate be? It would be a form that was not in either column.

Reply - I can answer that. I get so irritated when I hear in debates etc. the only defense of no transitions is that we can't define them. One debater repeated practically nothing but that for an hour. I think anyone could recognize an eyeball that couldn't see, an arm you couldn't use, a leg that couldn't walk, or a fin that was just a bump. Anyone could. You don't have to be a trained specialist. It really irks me to hear that the only excuse that we can't find any transitions is that we can't define them. That's very strange.

Ans. - Well, yes, except if we have no intermediate category in our taxonomic system, our taxonomic tradition forces us to put something like Archaeopteryx in one class or the other.

39. But if it had a half a feather, we'd be very glad to throw out the classification system. Nobody I've ever heard debating has ever used the ground rule that the only way we'll accept a transition is within the present classification system. Dr. Gish says it would take only

39. (cont.)

three or four of these truly in-between forms with partway structures to document evolution. Anybody on either side investigating this thing, if they found a transitional form that had a partially formed or evolved organ or structure, would be very happy to say, "You've got one for your side." I would. I'm looking for that.

Ans. - According to John Ostrom's current thinking about Archaeopteryx, he feels that, in a sense, the wings of Archaeopteryx were half formed wings.

Reply - This recent article from Science, Volume 29, March 9, 1979 shows that the primary feathers of Archaeopteryx were asymmetric and identical to those of modern flying birds. In non-flying birds like the emu, the primary feathers are symmetrical. Thus they say that Archaeopteryx flew. That supercedes some of those earlier statements that it was just a dinosaur with feathers.

Ans. - OK, I heard Ostrom talk about this at a lecture series in Chicago, It is his contention that they were used for trapping, not for flying but trapping.

Reply - This supercedes that.

Ans. - It could be. I have to look that up.

40. Now what about the teeth? Let's face it, we're concerned about what the textbooks say. The textbooks say that the teeth of Archaeopteryx show that it had a reptilian ancestry. How do you view that?

Here is the article on Archaeopteryx feathers.

Ans. - I haven't seen that.

41. What about the teeth? Textbooks say that is one good example of evolution. But, it's true that in every subclass of vertebrates, some have teeth and some do not.

Ans. - They certainly evolved many times.

42. Personally, I don't think that is compelling evidence of reptilian ancestry do you?

Ans. - No.

43. It is said in the museums that insectivores were the first mammals. What evidence do we have of that?

Ans. - It's too far out of my line.

44. Someone said in one of the other interviews that was just double talk in the halls with tourists.

Ans. - Ha! Ha! Ha!

This whole question of intermediates I think is questionable. For example, the insect life in the Carboniferous is wonderful. The insects were well out in hundreds of species.

My point is that during the Cretaceous there were 65 to 70 million years with virtually no insect fossils.

45. How do you explain that?

Ans. - Bad luck!

Reply - Ha! Ha!

Ans. - We have a choice of saying there were no insects in the Cretaceous. Insects are very difficult to preserve.

46. You say there are no insects in the Cretaceous?

Ans. - Virtually none. Just a handful of specimens, if that!

Reply - I don't think it's bad luck. Perhaps it has to do with the way the strata and fossils were deposited.

Ans. - Oh yes. I would certainly agree.

47. I've heard of some anomalies in geology which cast serious doubts about the validity of the traditional geologic column. For instance, you have no doubt heard of the numerous dinosaur and human tracks reported along the Paluxy River near Glen Rose, Texas. Certain scientific organizations have been publishing accusations that these tracks are hand carved. Now I must admit that some which were cut out and sold to tourists do look too good to be true. So, this May I went down to Glen Rose and examined the tracks which are visible above water.

Whatever they are, they absolutely are not hand carved. No one questions the dinosaur tracks of course, only the humanoid tracks. One particular

47. (cont.)

clear left right left sequence of a half dozen tracks on a ledge was stepped in by a 3 toed dinosaur at one point. During the filming of the movie, "Footprints in Stone", an overlying rock ledge was removed and an additional footprint was uncovered. There are undoubtedly more there awaiting uncover. These are unquestionably genuine footprints of some creature. Unless they were made by dinosaurs with humanlike feet, as some evolutionists have claimed, then a real serious re-examination of the geologic column is in order.

Ans. - That's a difficult question. We don't know how many of these reactions are reasonable and rational and how many are just emotional.

Reply - I checked that out with my own eyes. Now, I'm no expert in this field but it takes no expert to show that there is no foot that would match that shape other than man. It would be just as bad a problem if the tracks were made by any primate, of course.

Ans. - Sure.

Reply - The American Museum of Natural History had that movie; Dr. Patterson viewed it a half dozen times. You should see it. When it was shown in a local school in our area to a biology class, an author of one of our earth science books absolutely refused to look at it because he said it was impossible for dinosaurs and man to have coexisted. Now we don't want that type of person writing our textbooks.

Ans. - Of course not.

48. We don't want to jump to conclusions. We just want to show all of the evidence rather than conclusions.

Ans. - Yes. Although, on the other hand, if our geologic time scale is substantially correct -

Reply - But that is an assumption.

Ans. - Yes.

49. Do you know of any reason why you think it is valid?

Ans. - Yes. It is used very effectively every day to find petroleum.

Reply - Mineral geologists by the way don't seem to sympathize completely. Coal geologists, for instance, don't seem to go along with normal uniformitarian concepts that things were formed over millions of years. They say, "No way was coal formed over millions of years."

Ans. - Oh sure. That's a different problem. Episodic deposition versus a gradual slow deposition and I would be the first to agree.

50. Well, that wipes out several hundred million years of geologic time if you don't have coal forming over millions of years.

Ans. - No. No. I don't think so at all. There are two problems here. One is the sequence and the other is the amount of time involved. My earlier comment about the petroleum geologists - they always talk about sequence. The absolute time is an entirely different question.

Reply - ^{yes.} Oh Sequence is another thing. We can observe sequence. What about sequence?

Ans. - All I'm saying is that sequence is probably alright or we wouldn't be able to use it as effectively as we do in purely applied areas such as petroleum exploration.

51. Let's talk about sequences. Quite an issue is made about upside down sequences such as Pre-Cambrian setting on top of Cretaceous over many hundreds of square miles in Glacier National Park with no sign of rock movement. Yet the overthrust mechanism is used to explain away this very great problem for the geologic column. How do you explain that if you say the sequence holds up?

Ans. - I think it does, particularly in the Alps where the overthrust work originated. There you can see them. There is no question about it.

52. There are real overthrusts. I was just in Europe several weeks ago and observed places - at least in the Pyrenees Mountains - where the strata are absolutely vertical. But you can't use an overthrust in the Alps to solve Pre-Cambrian setting on Cretaceous in Glacier Park when there is no significant sign of rock movement and yet a huge block a hundred miles long is supposed to have overthrust 30 miles. Down in Texas you have the same sort of thing.

Ans. - OK. In a case like that, the structural geologist would say that because the Pre-Cambrian was above the Cretaceous there must have been thrusting.

53. Not all of them do. Some of them don't adhere to the geologic column. Some of them say the evidence does not support it.

Ans. - But I was talking about the establishment structural geologists.

54. A friend of mine, Bill Gates, has a presentation ^{on} this. Several years ago he moved to California and there spoke to the Southern California Section of the Ass'n of Engineering Geologists. He got almost no argument from most of them when he questioned the establishment interpretation. They know the geologic column cannot be substantiated.

Ans. - I wouldn't agree with that. The professional company geologists use it and depend on it every day. I am sure there are some iconoclasts

54. (Cont.)

and skeptics. If this geologic sequence were really a fabrication in the imagination of the geologist, then I don't think it would be as successful, as practically useful as it obviously is in oil and mineral exploration.

Reply - But it takes only one or two exceptions to disprove it.

Ans. - No, I don't think so.

55. If someone takes the exceptions, throws them out and refuses to talk about them, then it makes me suspicious. This is the part that bothers me the most. I think there are sequences like this in the Grand Canyon etc. Do you know what that sequence shows? From the Vishnu Schist at the bottom of the Cambrian in the Grand Canyon all the way to the top of the Cenozoic in Bryce Canyon, there is not to be found a single soil layer or unconformity. Yet that covers about 500 million years supposedly with many millions of years missing. I don't know how to piece it all together, but it surely does not fit in with the uniformitarian concept. I think that's just as devoid of real evidence as this slow and gradual evolution with all the transitions.

Ans. - OK. The uniformitarian concept in the sense of gradualism, I think was a vast exaggeration, but I don't think noting that messes up the time scale per se.

Reply - Now we're talking about time scale and sequence. They are two different things. Let me talk about time. I've plotted a histogram of published C-14 dates based on data from a paper by Dr. Whitlaw of VPI. This data is on the first 15,000 C-14 dates published in the literature. This plot reveals a huge discontinuity about 6000 years ago.

Ans. - Maybe that was due to just one or two papers that just had a lot of dates.

Reply - No, these are all the thousands of samples reported from many sources. These dates of course assume a constant tank of C-14 in the atmosphere which we know is incorrect since it is not in equilibrium and is still building up. If this observable fact is accounted for, the dates would be compressed down perhaps exponentially. Since this paper was written, the total of C-14 dated items has climbed to over 40,000 and they show the same pattern. C-14 dating can be verified back to about 8,000 years B.P. by tree ring analysis.

Ans. - Right.

56. How do you handle the age of the moon? According to ^{the} precisely measured micrometeorite deposition rate (1.4 millionths of an inch per year), the moon should have 54 feet of dust if it were 4.5 billion years old. But it has less than 10,000 years of dust all over it. Have you noticed that there hasn't been one paper written on this in the 10 years since we landed on the moon, but millions of dollars had been spent preparing for a possible huge blanket of dust. How do you account for that? Are you aware of what recent space discoveries have done to the commonly used potassium-argon radiometric dating technique?

56. (cont.)

Ans. - No, I am not.

57. What NASA found on the moon, Mars and Venus solves the mystery of why the K-A dates are often in error by a factor of about one million when lava rocks of known age are dated. For instance, rocks in Hawaii known to be 200 years old give ages in the millions of years (with K-A dating).

When potassium 40 (K-40) decomposes radioactively it forms two daughter products, calcium 40 and argon 40. The branching ratio (amount of each) is not known so it is simply assumed. There is no way of separating the calcium in the rock formed by decay of K-40 from other Ca-40 in the rock. But scientists thought they could work with the argon to date the rock. All of the argon 40 in the rock didn't come from the decay of K-40 either. So they just assumed that the same 300 to 1 ratio of A-40 to A-36 which exists in earth's atmosphere has always been constant. To separate the radiogenically formed A-40 from primordial A-40 in a rock, they measure the A-36 in the rock and multiply by 300. The difference between this number and the total A-40 in the rock is assumed to be the amount of A-40 formed from decomposition of K-40. Then they apply the assumed, not measured, branching ratio and date the rock very precisely to tenths of millions of years.

When we got to the moon, we found a very high amount of argon and the K-A technique didn't work. Moon rocks gave K-A dates all the way up to 20 billion years.

Mars was no better. Its atmosphere had a much higher than 300 to 1 ratio of argon 40 to argon 36. This was rationalized away by assuming that the solar wind blew most of the argon 36 away because Mars has a weaker magnetic field than earth.

When we got to Venus, NASA scientists were really shocked because its atmosphere contained 200 to 300 times less argon 36 than earth.

These discoveries cast serious doubts on the assumption that the earth's atmosphere has always had a 300:1 ratio of A-40 to A-36. A recent NASA space note said that these discoveries wipe out practically all theories on solar system formation. John Read, a NASA scientist wrote that this also destroys all credence in K-A dates. We're not sure these dates can even be used to show sequence of formation due to the strong possibility of argon leaching out of the rock or in from the atmosphere.

Ans. - I know nothing about this except that it is widely used in dating.

58. Have you any opinion of Australopithecus as an upright walking ape.

Ans. - Not at all.

59. In the New York Biology Syllabus we have embryology used. What is your opinion of embryology being used as evidence for evolution, in other words, embryological recapitulation - the human embryo has gill slits etc.

Ans. - Well, the Biogenetic Law - - embryologic recapitulation, I think, was debunked back in the 1920's by the embryologists. I don't see embryology as any different than any other kind of comparative morphology, similarities being in stages or adult morphology.

60. OK then, homology, do you not see that as compelling evidence for evolution? Homology - the similarities of bones in the human arm, a horse's leg and a whale's flipper.

Ans. - No. No. Because I can see -

Reply - There are some people who do.

Ans. - But there are other ways to explain this - other models which could be used.

Reply - I know.

61. You mentioned some other conflicts in your paper between Darwinism and paleontology. What are they?

Ans. - Surely the lack of gradualism - the lack of intermediates - is a major problem.

Another problem is the assumption we get from Darwinism that all structures are adaptive. This is a very difficult thing to prove. It is easy to prove that a structure is adaptive but it is impossible to prove that another structure is not adaptive, therefore, by default we are comfortable with the traditional assumption that all structures are adaptive.

62. What do you see as a mechanism for evolution? Do you agree with the textbook explanation that random mutations worked upon by natural selection is the mechanism for evolution?

Ans. - I think that's part of the explanation, on a small scale. Mutations and recombinations explain part of it.

Let's put it this way: If that were the whole story, I don't think the fossil record would look the way that it does.

63. What's your explanation for how it looks?

Ans. - I don't know. That's one of the reasons I have so much fun in research.

If you were to take two or three of the top flight population geneticists who didn't know the first thing about the fossil record (that shouldn't be too hard to find), put them in a room and ask them to describe what they thought the last 600 million years of the record would look like, I'm quite sure that they would come up with something totally different, because (and many of my colleagues don't agree with me on this) I think the evolutionary system would have come to a steady state long before now. As adaptation proceeded as an optimization process, which I think is perfectly fine, global optima would have been found and the biological system would have been sitting on that for a long time. There is no evidence of this slowing down - of steady state. There is as much turn-over in the late fossil record as in early fossil record.

These and other things I find not as the most logical predictions of the basic Darwinian model. This isn't to say that I deny the Darwin model for it works on a small scale but I think there are some major ingredients that we are missing.

64. I think there is zero difference between the classical evolution model and creation model on a small scale. It is the bridging of the big gaps where the contention arises. Nobody argues about the variations.

Ans. - Yes.

Reply - There is a new wing in the Smithsonian on evolution. I was just there and took a number of pictures last week. If the title on the door were changed to Variation or Micro Evolution, I doubt if anyone would find much fault with it.

Ans. - Dr. Porter Kier was one of the defendants in the lawsuit.

65. You pointed out that any geneticist who didn't know much about the fossil record would make certain predictions. I agree with you. It is pretty obvious that anyone would. People talk about these problems.

In Dr. Eldredge's interview, he kept saying over and over, "These are just two basic axioms. I don't necessarily believe either one but I've accepted the evolution assumption, or axiom, because I can go out and study nature better based on the predictions I can make with it." But he said that you can't falsify it. Now, I don't quite understand that. Every prediction you would make on the basis of evolution, virtually, has been falsified. How can people say that you can't falsify it?

Ans. - I think it is certainly falsifiable.

66. Then how come it is not falsified when the bottom rocks containing most, if not all, major animal phyla appear suddenly? Why doesn't it falsify it when we look for every one of these intermediates and they are not there?

Ans. - Well, whether it's valid or not, it's still possible to rationalize the lack of intermediates - rationalize it by simply modifying the original Darwinian theory.

67. In debates, people say, "Sure, the original Darwinian theory has been falsified, but we'll come up with a new one as fast as you can disprove the old ones."

Ans. - I think that's true of any conventional wisdom.

68. But that's not science. You've got to have a theory which is subject to falsification, and if it's falsified, throw in the towel. Now if you want to come up with a new theory OK. But after it has been changed a hundred times and it is still falsified, at some point, someone ought to throw in the towel. Maybe you could say, "We don't know.", but don't put it in the textbooks and say it has been proven as well as any fact of science.

Ans. - Yes. I'm sure you've seen how slowly conventional wisdom dies and it really takes overkill.

Reply - In my work, when we ship a flight control system for an airplane out the door, it's got to work or someone is held accountable. We must not speculate. But these people go on and speculate for a hundred years and nobody puts them to the test.

Ans. - Well, that gets back to my point about the sequence aspect of the geologic column. It does go out the door as a practical instrument for petroleum exploration and it works.

69. There are sequences.

Ans. - If an oil company is looking for Cretaceous because experience has shown that Cretaceous in that region is more likely to produce oil than any other rock, if they find themselves in the Jurassic, they go up.

70. But when they find Pre-Cambrian sitting on top of Cretaceous like the hundreds of square miles of it in Glacier National Park with no sign of an overthrust, they just ignore the geologic column when the time is right because they know better.

Ans. - Oh, sure.

71. Now, that only says that there might be another model. Part of the time their model doesn't work. I have a great curiosity here. I'm not just gathering information for the schools. My personal feeling is that there is something badly wrong. Everything I've checked into, virtually except some of the sequences, I find is just totally unscientific, pure pseudo-science of the worst kind.

For instance, the origin of life thing they teach in the schools - the Fox idea. I can show you with the best science that there is no way for even a portion of the DNA for a single cell to have arisen by random processes. Just the tiny part of DNA that codes hemoglobin takes about 1000 rungs on the DNA molecule ladder to code 315 amino acids. These rungs are made up of only four bases so there are 4^{1000} or 10^{602} different combinations possible. The improbability of that precise code forming by random processes is beyond all comprehension. The evolutionist says, "Given enough time, anything can happen." But in 30 billion years there are 10^{18} seconds. If you were to combine the exact proper four chemicals a billion times a second (10^9) for 30 billion years, you would make only 10^{27} attempts. To illustrate the size of the number 10^{602} , there are 10^{80} electrons in the entire 10 billion light year diameter universe which is mostly empty space. If it were filled chuck full of electron size particles, they would number 10^{121} . Dr. Fox has refused repeatedly to defend his position in a public forum and this year backed out of a scheduled debate in Miami even after his picture was published in the Miami newspaper announcing the debate. Neither Dr. Patterson nor Dr. Eldredge could give me any explanation of the origination of the first cell.

Ans. I can't either.

72. One position is that if students are given some alternatives, especially in speculative areas like this, they will learn much faster. In fact in a carefully controlled test in schools in Wisconsin where students were taught both ways, (only evolution and two models) without pushing either one, the students who were taught two models got higher test scores on the evolution questions than the students who were taught only evolution.

Ans. But in practical terms in a curriculum it would be difficult.

73. Just two basic concepts could be taught, no religion, no Genesis.

Ans. - There are some basic differences in interpretation of observations.

74. You don't put that in. You must put down the two axioms in the books and list the physical evidence, no interpretations.

Ans. - Yes, I know, but just describing the physical evidence it's pretty hard to avoid some interpreting.

75. That's why you get people from both sides to help write the material.

75. (cont.)

Ans. - You have to have both interpretations of the Cretaceous footprints for example which means that you almost have to have the cooperation of the evolution establishment.

76. But nobody died and left them in charge. People in the education department must be impartial. The Supreme Court ruled in the Madalyn Murray O'Hair case that the state shall not prescribe a philosophical belief system. Yet, a philosophical belief system is being taught as a fact right now.

Ans. - If the theory of evolution were to be completely debunked tomorrow, we wouldn't need to rewrite one iota of our stratigraphic column. It strictly depends on clay marks on rocks.

77. You don't think the geologic column would need to be revised if it were shown that dinosaur and human prints were truly contemporaneous?

Ans. - If it were shown that primates and dinosaurs lived at the same time, yes you would have to revise something like when they found coelecanth fish alive.

78. Suppose you found that trilobites and man coexisted, you wouldn't have to revise anything?

Ans. - Sure, you would have to revise the geologic column. I said, "If the theory of evolution were debunked, then you wouldn't have to change the column." Everyday the stratigrapher finds organisms that yesterday he didn't think occurred together. What I'm trying to do is separate the use of fossils in making the column from the use of fossils in interpreting evolution.

Reply - That's great!

Ans. - They are two separate things.

79. I agree with you but I don't think it has been done that way. I have many books which say in effect that the geologic column is used to prove evolution and evolution is used to prove the geologic column.

Ans. - OK. What you are getting at there is I think you are a victim of naive textbooks writing.

80. I'm not the victim. I'm only telling what the books say. I don't agree with this circular reasoning.

Ans. - Some of the older, lower level, poorly written textbooks - I think it would be the majority - thought that the geologic column was based on the theory of evolution. But, to one who has been in the trade for a quarter of a century, it just isn't so.

81. I have color photos of an alledged human sandal print containing clear trilobite fossils. If I can get hold of that rock, will you examine it?

Ans. - Sure.

Reply - If that is legitimate, I think it would require some drastic revision of the geologic column.

Ans. - Unquestionably.

82. So, for the record, you don't think that the geologic column was based upon the assumption of evolution. I think I have seen that contention in writing.

Ans. - Yes, I'm sure you have, but the simplest evidence is that the geologic column was not affected in any significant way by the acceptance by geologists of evolution. Agassiz, who was a strong anti-evolutionist did just as well and was just as comfortable with the geologic column as other people who were strong proponents of evolution.

83. What do you think of the Hopeful Monster explanation for the lack of any transitional forms which Dr. Gould is predicting will be vindicated within a decade?

Ans. - All of the authors of the Neo-Darwinian theory which they formulated back in the thirties and forties are losing their influence. They are getting old and dying off. I predict that that whole concept will be thrown out in the next ten years and a new theory will be devised to take its place. A new wave of thinking is sweeping the field.

84. What will it be?

Ans. - I have no idea.

85. Thank you Dr. Raup. This information will be most helpful to those in public education who are revising guidelines on the teaching of origins. A number of states are now reconsidering this subject. What you have said about the fossil record indicates that some significant revisions are in order.

September 11, 1979

INTERVIEW: DR. DONALD FISHER
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WITH

LUTHER D. SUNDERLAND

Dr. Fisher, I would like to ask you some questions about the characteristics of the fossil record, in particular, as it relates to the subject of origins. Dr. Van Hooft suggested that I speak with you since you are the New York State Education Department's expert on paleontology. I recently interviewed representatives of three of the world's largest fossil museums in London, New York City and Chicago and will be asking you many of the same questions. Since the fossil record is the only direct scientific evidence relating to what really happened to life upon the earth, I shall be examining it in some detail.

1. Are Cambrian rocks found in New York State?

Ans. - Yes, we have Cambrian rocks.

2. Do we have Pre-Cambrian rocks as well?

Ans. - The Pre-Cambrian are metamorphosed so the chances of finding fossils would be very remote.

3. What do you find in the Cambrian rocks? Do you know how many animal phyla are found here?

Ans. - (Referring to chart on wall) Whenever a fossil is shown here in the Early Cambrian, it means you have a paleontologic control for the age of that particular rock unit.

4. Then you date these rocks strictly by the fossils they contain? You don't have any radiometric dating for the paleo rocks?

Ans. - That's right for the Cambrian rocks. We do have radiometric dates for other rocks in the column but not in the Cambrian. All of our Cambrian rocks are sedimentary rocks. In adjacent Massachusetts and Vermont there are metamorphic Cambrian (heated and distorted) rocks, and there are also some very small igneous (lava) dikes of Cambrian age.

Most of our diagnostic fossils for correlation purposes are trilobites.

5. Those are your Cambrian index fossils?

Yes. In fact, most of the Cambrian is zoned on the basis of trilobites. There are other fossils in the Cambrian rocks but they are not useful as yet for correlation purposes. We don't know enough about them. There are strange looking things in the Cambrian which don't have an affinity with the organisms living today. Many of the fossils in the Cambrian are phosphatic. This is a little puzzling because no other portion of the geologic time scale has as large a portion of phosphatic fossils as the Cambrian does. Whether the shelly fossils had not yet developed their calcium carbonate shells at the time, we don't know.

6. What is a phosphatic fossil?

Ans. - One that contains calcium phosphate shells rather than calcium carbonate.

7. Does that mean the shells have not yet been replaced with anything?

Ans. - Some of them have been replaced by silica, but others have not.

8. Now, you say you date different Cambrian rocks by the different species of trilobites they contain. Do you ever find the trilobite species in an ordered sequence of rocks?

Ans. - If you are lucky, you may find them in a particular stratigraphic section or a single geographic area.

9. In sequence?

Ans. - In sequence. For example, in eastern New York in Columbia County we have the Germantown formation which is in part Cambrian and the other part is Ordovician. We have a number of sequences of trilobites here and other fossils. We are not always that fortunate and have to do piecemeal stratigraphy so-called. We take a section from one area and dovetail it with a section from another area.

10. Are there any soft-bodied creatures found here in the Cambrian?

Ans. - No.

11. The July 79 issue of Scientific American says that 4 of the 15 soft-bodied animal phyla are found in the Burgess Shale Cambrian of Canada. How come there are none found here.

Ans. - I don't know. The vagaries of preservation affect preservation of these creatures.

12. We have no soft-bodied creatures in the Cambrian?

Ans. - We have some a little higher up in the Ordovician that are thought to be jellyfish.

13. How many animal phyla are found in the Cambrian here?

Ans. - There may be some question of the exact classification - whether they are phyla or not. Let's mention the groups. We have trilobites and fossil tubes that don't fit the modern phyla.

14. Aren't worms soft-bodied?

Ans. - Yes, but while we don't have the animal itself preserved, we do have mineral tubes they made. We have no corals in the Cambrian and a few brachiopods. No crinoids. We have algae.

15. Just stromatolites?

Ans. - Yes we do have stromatolites that look like fossil cabbages. We have fossil snails - only the shells. We have no clams, bryozoans or cephalopods in the Cambrian here.

16. All of the Pre-Cambrian here is metamorphosed, but some places the Pre-Cambrian grades continuously for 5,000 feet or more into the Cambrian?

Ans. - Right. In the southern Appalachians in particular and one of the best examples is in Glacier Park. They have thousands of feet of sedimentary rock beneath the bottom trilobite zone. There are other places in Siberia where it goes down thousands of meters below the lowest trilobite zone into unmetamorphosed rock. So the placement of the base of the Cambrian is a real problem.

17. Do you agree with Dr. Preston Cloud that no multicelled creatures have been found in the Pre-Cambrian?

Ans. - I don't know if I can agree or disagree. I can't care much where they put the base of the Cambrian. It is a very arbitrary placement. As long as a committee of experts decide once and for all where they are going to put it, fine. (Such a committee of world experts has been formed to establish each of the geologic period boundaries.) Right now there are many differences of opinion so if someone talks about the Cambrian we aren't sure if they are talking about the lowest trilobite zones or something else.

18. As far as the teaching of evolution in schools is concerned, the beginning of the Cambrian is quite pertinent. How do you account for this great diversity of life in the Cambrian with no ancestors? Do you have any philosophy on that?

Ans. - There are many factors involved. I think one of the factors is that there may be a relatively small proportion of unmetamorphosed sedimentary rocks in that part of the geologic column. If you have less rocks to look at obviously you are going to have fewer fossils. Also, I'm not quite sure that these rocks have been investigated to the degree that the others have. My impression is that they have not. I think it is a question of looking.

19. Dr. Eldredge said that it's been pretty well explored and we can't appeal to the "rotten record" explanation anymore. He said that the Cambrian explosion is a real phenomenon. If evolution ever really took place and structures arose gradually where there previously were no structures, like eyeballs, legs or fins, then there must have been some ancestors. We are looking for some real scientific evidence for these ancestors. The story I get is that just abruptly characteristics appear. When we find the first jellyfish, it's a jellyfish; the first pelacypod, it's a pelacypod; and the first trilobite, it's a trilobite. I'm looking for any evidence whatsoever of this progression.

19. There are people who say that evolution did not occur and this is the competing concept. I'm looking for any scientific evidence that would refute their contention.

Ans. - First of all, I'm not so sure that they abruptly appear. I think it's a factor of the chances of preservation.

20. If something is there and it wasn't there before, that is what I mean by abrupt, regardless of the time that precedes it.

Ans. - Of course we don't know that it wasn't there before, we just haven't found it. It's a question of finding it. You have to differentiate, is it there and you haven't found it or isn't it there?

21. Now, if you dig down in the rocks below a fossil bearing formation in rocks supposedly older and you don't find any ancestors, that is what I would mean by abrupt. We don't want to get into a discussion of how many years elapsed between the deposition of the stratum that did have fossils and the stratum that did not. What we are looking for is any evidence whatsoever to support the material in the textbooks now which says evolution really happened. We want to put into the textbooks what we really find and then let students draw their own deductions. That is what we are trying to sort out.

Now, May 5, 1978 Science magazine reported the discovery of fish in Upper Cambrian in Wyoming. Were they fish?

Ans. - Yes, I happen to know the fellow who discovered it. He is John Repetski of the U.S. Geological Survey.

22. Were they really vertebrates?

Ans. - I think so.

23. I got some disagreement on that from Dr. Patterson.

Ans. - I don't believe Mr. Repetski would have reported them as fish if they weren't. I've only seen pictures of the specimens myself.

24. How deep in feet below the surface does the Paleozoic extend in New York State?

Ans. - The deepest well is the Qlin well in western New York and that has gone down about 12,000 feet. They were pretty close to the bottom of the Paleozoic, in the Potsdam sandstone. That was a dry hole.

25. Is there any coal in New York State?

Ans. - No.

26. Then there is no Carboniferous?

Ans. - There are some Carboniferous rocks but they are not coal bearing.

26. We have one formation of Pennsylvanian age; that is the Olean conglomerate. It occurs out in Allegany and Cattaraugus counties. The Knapp Formation is Mississippian age. It consists of sandstones and shales. It is a marine deposit.
27. How do you think coal formed?
Ans. - I think coal was formed in lagoons, like the Everglades of today. The rotting vegetation was buried under the water.
28. How would a 50-foot coal seam form in a peat bog?
Ans. - You could have this over a long period of time.
29. You mean millions of years?
Ans. - Probably not. Probably in terms of thousands.
30. Wouldn't the wood have decayed?
Ans. - Not necessarily.
31. What would keep it from decaying?
Ans. - If oxygen is kept away from the decaying matter it wouldn't oxidize.
32. Do you have examples of that going on today where oxygen is being kept away?
Ans. - Yes. We have that today in the peat bogs in New York State. Things die and fall down and the peat accumulates.
33. You subscribe to the peat bog theory?
Ans. - Yes.
34. Are the vegetations found then in the Pennsylvanian, peat bog type vegetation?
Ans. - I don't know whether all of them are but I would suspect that they certainly are representative.
35. A friend of mine received his Ph.D. from Penn State in geology, specializing in the study of coal. He has some theories about this. Are you familiar with cyclothem?
Ans. - Yes. That goes back a number of years.
36. He claims there are coarse conglomerates on the bottom - gravel, then sandstone, limestone and coal with finer siltstone on top. He thinks they are formed by wave action which dumped the heavier material first in shallow inland seas as the continents were being elevated. The coal beds stretched from New Jersey to Denver.

36. Ans. - That's a good explanation when you have the cyclothems but when you don't and you have a coal bed, you have to call on some other mechanism.

37. I've gone through the coal beds and I don't find the peat bog explanation as being very valid. It seems as though the vegetation would have needed to have been covered very rapidly to prevent decay and I don't know of any peat bog today where there is coal being formed in the bottom of it.

Ans. - You would need some pressure there. You would need the weight of overlying sediments.

38. Somehow you had to get it covered fairly quickly.

Ans. - Yes. The coal was not formed at the surface, definitely not.

39. Did you read Velikovsky's book, Earth in Upheaval?

Ans. - Yes.

40. In Velikovsky's book he said that you would need 12 feet of peat to make 1 foot of coal and 10 feet of plant remains to make a foot of peat. Even if these numbers were considered to be on the high side by an order of magnitude, it would still take hundreds of feet of vegetation to make a 50-foot thick coal seam like we have in Antarctica. The oxygen had to be blocked out immediately from this tremendous heap to prevent decay. Where is that sort of thing going on? He explained it by some sort of inter-planetary catastrophe.

Ans. - Of course, the problem is that you've got coals not only in the Pennsylvanian but many times in the Mesozoic and even in the Cenozoic. Are you going to have a near miss of Venus or Mars everytime coal is formed?

41. That's interesting. What do you know about the radiocarbon dates for coal? Are you aware of 5,000 year B.P. dates for coal?

Ans. - No.

42. A paper by Dr. Whitelaw of VPI surveying the first 15,000 published radiocarbon dates up to about 1970 revealed some very unusual things. Because of its 5,700 year half life, radiocarbon can be used for dating only back to about 50 or 60 thousand years.

Ans. - About 50,000 years.

43. So you shouldn't be able to date coal that is millions of years old. The most significant thing he found was that no form of life is any older than any other form of life according to published radiocarbon dates. Coal dates are scattered all the way from 5,000 years back.

Ans. - You have to first of all determine where you are in the stratigraphic column when you are dating these things and even if it is really coal. A lot of things are called coal that aren't. I don't believe that the scientific evidence supports this statement, (about radiocarbon dates) at all. Don't forget the U-Pb, K-A, Rb-Sr dating.

44. Getting to the fish reported in Upper Cambrian, you feel that it is valid?

Ans. - When you analyze the reports of some of these things, you have to know the person who is making the report. If he is a competent, reliable person that isn't looking for publicity, that means a great deal.

Reply - And you know the person who reported the Cambrian fish fossils.

45. The appearance of amphibians occurs somewhere in the middle of the Paleozoic.

Ans. - In the Devonian, I believe.

46. Do you know of any fish growing feet and legs, any transitional forms?

Ans. - Any transitional forms?

Reply - Yes.

Ans. - I'm not a paleoichthyologist so I wouldn't want to comment on that.

47. No one else knew of any either, so don't feel badly.

Ans. - I think you would have to talk to someone like Bob Schaeffer at the American Museum.

48. What we are looking for is, somewhere in the fossil record, a partway structure - a partway leg or partway fin - to substantiate what is being taught in the schools today.

Ans. - Well, I think probably what happens when they talk about evolution, someone is looking for a transitional or halfway form between this form and this form, and you are not going to find that because in the study of evolution you have to deal with a certain grouping, a certain family. If you are talking about the spiriferid brachiopods, a person can work up a beautiful transition in the fossil record from the oldest spiriferid brachiopod to the youngest spiriferid brachiopod. But you won't necessarily find a transition between that family and another family of brachiopods however. What they are looking at is evolution within certain groups, and that is well documented.

Reply - Absolutely.

Ans. - Evolution between larger groups is not. That is another story.

49. Fine. That is the kind of information we want to put in the textbooks.

Ans. - Right.

50. We don't want to make up stories.

Ans. - If they are making up a syllabus for New York State, we can document that with, say, the spiriferid brachiopods of New York. We can do it with certain trilobite families very nicely too.

51. Then we have the appearance of reptiles. Where do they come in?

Ans. - Reptiles are in the Carboniferous.

52. About the same time as the amphibians?

Ans. - The amphibians are a bit older. Amphibians from Greenland are in the Devonian.

53. Reptiles are there. Now, what we are looking for is any indication of ancestry. We do find nests of fossilized hard shelled dinosaur eggs.

Ans. - Now there are some forms that the vertebrate paleontologists have a hard time in classifying as amphibians or reptiles. Some of those are in Romer's book.

54. Yes, it has been pointed out that there is a difficulty in classifying certain skeletons. However, when you look at the egg of a frog or salamander and compare it with the hard shelled amniote egg of a reptile you can see a revolution in structure. There is no question about the classification there.

Ans. - Yes.

55. When you look at the egg, to imagine a transition there stretches the imagination pretty far. The hard shelled amniote egg is just totally different from the soft egg of amphibians. The stories in the textbooks that we teach the school students (I have to keep referring to this because a lot of misinformation has been given out and we are trying to correct that) is that during the Devonian, a drought came along and some inland fish had to walk overland to get to water. Over 50 million years or so he grew feet and legs along with a hard shell for his eggs. Now that sounds kind of far-fetched when you spell it out, but that is what the textbooks say really happened.

Ans. - Yes.

Reply - We don't want to put that in if it's just imagination.

Ans. - Yes. As you say, the textbooks fail to distinguish whether you are talking about this change taking place in an individual or is it taking place over thousands of years in several generations.

56. No. I wouldn't fault them that way. No, I think the word that has gone out is individuals don't evolve, populations evolve. That is clear. But let's face it, for a population to evolve, it must have some in-between forms too. They can't just jump. At least, not according to Simpson.

Now, as you know, Drs. Gould and Eldredge (and before them back in 1940, Dr. Goldschmidt) say that there are no in-between forms since we don't find them. It's not because of the record, it's not because of preservation problems, it's because there weren't any.

Ans. - Do they really say this?

Reply - Dr. Gould wrote in the June-July 1977, Natural History magazine, "The fossil record with its abrupt transitions offers no support for gradual change, ..."

56. For instance, Goldschmidt said that a reptile laid an egg and a bird was hatched from the egg. That, however, is not science as you well know.

Ans. - Yes.

57. It may sound good to someone to say that individuals don't evolve, populations evolve so they don't have to picture this transition. But, somewhere along the line there had to be a halfway fish and a halfway amphibian or a halfway dinosaur and a halfway bird.

What do you feel about the reptile to bird transition? Archaeopteryx was found in Jurassic?

Ans. - Yes, Upper Jurassic of Germany. The person to talk to on that is Dr. John Ostrom of Yale Museum. He happened to have been a student of mine. I taught him paleontology at Union College here in Schenectady.

58. August 78 issue of National Geographic showed a picture of him examining a modern bird femur found in Upper Jurassic rock the same age as that in which Archaeopteryx was found. I understand that he has been quoted as concluding that we would now just have to look for the ancestors of birds in rock much older than that in which Archaeopteryx was found. Obviously, if they are found side-by-side, that doesn't prove anything about Archaeopteryx being the ancestor of birds.

Ans. - Yes.

59. Do you know anything about that, how feathers might have arisen from scales?

Ans. - None whatsoever.

Reply - I've heard that feathers don't even come from the same layer of skin as do scales.

60. Do you know of any fossils being formed today?

Ans. - Oh yes. Lots of places on the bottom of the sea.

61. Where?

Ans. - The Australian barrier reef is a good example. When the corals die their old houses, so to speak - become fossilized.

62. Do you know of things like fish with flesh that are being fossilized? We find many fossilized fish with scales and the whole fish preserved. Are there any being fossilized today?

Ans. - I can't give you any specific examples but I'm sure that they are finding them on the sea floor today.

63. On the basis of what? Just assumptions, or do you know of any?

Ans. - When the skeletons fall to the sea floor, I'm sure that a certain percentage of those are being covered with sediment.

64. Have you ever dug any up?

Ans. - Did I see it? I haven't seen it, no.

65. You've never heard of any either?

Ans. - Well, you would have to be in contact with a marine laboratory that is studying the sea floor.

66. See, this is where we are trying to sift out the conjecture from the facts. The conjecture is that these thick layers of fish fossils were formed over millions of years as sediments covered the dead fish but we don't find them on the bottom of any ocean, sea or lake. Now, Dr. Patterson said that he knows of a few very rare cases where they dredged up a dead fish that was lying on the bottom. He assumes that they had floated to the surface and burst. Normally a dead fish just floats to the surface and is consumed.

Ans. - One of our problems of course is that man has such a short span of life that he can't observe these things happening either.

67. But if you went down an inch, you should find something that was there thousands or millions of years ago.

Ans. -
You asked me if I ever saw fossils forming. You really have to be in the right spot at the right time to see this. Of course, then you have the law of probability.

68. Or you have to be able to dig up what was deposited.

Ans. - Now, there is a place near Albany where I can take students and show them fossils being formed. That's up in Geyser Park at Saratoga. As the leaves fall off the trees in the fall, they form on the mineral charged waters and the mineral matter is precipitating out on the leaves. You can see fossils being formed. As you pick up a leaf you can see the minerals on it. If you dig down, the leaves are harder and less fragile.

69. Creation Research published a photo of a fossilized bat that had died on a stalagmite and then fossilized rather quickly by the dripping calcium containing water.

Ans. - Sure. You have to be in the right place at the right time.

70. Still we have billions and billions of fossils all thrown together. For instance, down at Glen Rose, Texas Dr. Steve Austin, a geologist, told me that he found something just as significant as the many dinosaur and human tracks there. This is a three foot layer of pelecypods all with their valves closed. How could pelecypods get formed into fossils over millions of years without their valves opening? They had to have been covered suddenly.

Ans. - Oh yes. We've seen that with brachiopods here in New York. We have brachiopods with their valves closed. There had to have been a catastrophic covering of sediments.

71. But the books on evolution don't allow anything more than a little local flood. That's the point.

Ans. - Oh, I see. Well, I'm sure there have been many catastrophes in geologic history. What we are looking at when we see one bedding plane covered with an unusual fossil that isn't found throughout the sequence is some kind of a catastrophe. Whether it was a tremendous mud flow, earthquake, you name it.

72. But these are all very local. Nothing very large.

Ans. - On a worldwide scale?

73. Or even on a continental scale.

Ans. - Yes, they are probably not on a worldwide scale.

74. The way it is being taught in schools, uniformitarianism permits nothing more than local catastrophes.

Ans. - Yes. But what do you mean by local?

75. Anything that doesn't allow a big flood. Let's face it. The authors of uniformitarianism were out to get the big flood idea. That's what they were out to disprove.

Ans. - I've got my own idea on that.

76. Do you know of any transitional forms between the higher taxa.?

Ans. - Intermediates within families and even with orders but not between phyla. Nor do I think you will ever find any between phyla.

77. But why not if evolution really happened? Why wouldn't you? If a cow, for instance, in one phylum, originated from something that was in another phylum, why wouldn't you find something in between?

Ans. - The fossil record is not complete or even nearly complete.

78. We know that, but that might also be because there never were any intermediates. So if we want to be objective, we must hold both possibilities open.

Ans. - You can either say that there are no transitional forms, or you can say that because of the vagaries of preservation, only one in ten million of this particular species was ever preserved.

79. But the creationist has an answer for that. He says that you only get fossils forming in a catastrophe - a big catastrophe. That makes a lot of sense when you find ten billion fossils in one formation alone. That goes against the evolution model that says that fossils were formed over millions of years and you hardly ever get one formed. The other model says that you only get fossils formed in a catastrophe or catastrophes and that is why you don't find many of them forming today and why they were all piled together in the past.

So there is another explanation and it isn't necessarily a logical deduction that although we don't find fossils slowly forming, they actually did form slowly in the past and although we don't find transitional forms, they actually did exist.

Evolution says everything radiated out from a common ancestor. Now the proposition of the evolutionist is that at some point there was a candid photograph taken when some fossils were laid down - in the Carboniferous for example. There is the coal with all that vegetation. The evolutionist says that layer of coal represents millions of years of deposition or some length of time. The creationist says it represents some unusual deposition mechanism over some short period of time.

Now, if you take a candid snapshot at any one time when two or three million species were being originated, what is the probability that you would not capture any transitional forms where new structures were being formed? I haven't been able to find one expert in any museum that could show me a fossil of a partway formed organ, a partway eye, a partway fin, a partway scale, or a partway feather. I couldn't find a single example.

So, now the evolutionist is forced to call on the laws of improbability. When you take a candid snapshot of a million or so species, many of which were changing into something else, not one single transitional form can be found with a partway formed organ.

What do you find? The creationist says you find much variation within well defined boundaries, like all dogs probably came from a common wolflike

creature. Many within the genus Canis can and do interbreed and produce fertile offspring. That much of evolution is fact. Everyone agrees. The disagreement comes when the evolutionist extrapolates from a small amount of observable evidence such as different shaped finches beaks to claim man and all life came from a common one-celled ancestor. Yet, everything you find in the fossil record is fully functional. This is the kind of information that needs to be gotten out to the people who are writing the textbooks. Then the students can compare the facts against the two models and draw their own conclusions. We should include only objective science.

Ans. - Yes. Give them the data and the interpretation will be theirs.

Reply - Thank you Dr. Fisher. I appreciate all the time you have spent with this interview.

80. Additional comment to question 70.

Ans. - I have since checked into this. The dinosaur tracks are in rock; the "human" tracks are in adjacent sediment.

Reply - I have examined and photographed these dinosaur and alleged human tracks this year. Both are absolutely in the same stratum, they cross one another and the dinosaur stepped into the human track in several places. They could not have been carved as some have claimed.

March 27, 1980

INTERVIEW: DR. DAVID PILBEAM
CURATOR OF PEABODY MUSEUM OF NATURAL HISTORY

WITH
LUTHER D. SUNDERLAND

(Dr. Pilbeam wrote an article for Human Nature magazine, June 1978 entitled, "Rearranging Our Family Tree." In it he reported that discoveries since 1976 have shaken his view of human origins and forced a change in our ideas of our early ancestors. Previous views were wrong about tool use replacing canine teeth, evidence for which is totally lacking. He does not believe any longer that he is likely to hit on the true or correct story of the origin of man. He repeated a number of times that our theories have clearly reflected our current ideologies instead of the actual data. Too often it has reflected back only what we expect of it.)

1. Dr. Pilbeam, perhaps you would like to make some recommendations on what should be taught in public schools regarding human origins. Do you specialize in more than just humanoids? Do you cover all primates?

Ans. Yes, I teach a course that covers primates.

2. What are you doing now in Kenya?

Ans. Actually I am working in an area larger than just Kenya, advising the Kenya Government on the establishment of an international institute for the study of human origins.

3. I just spoke with Mary Leakey last month at an evolution conference at Hobart College. Do you get to see her in Africa?

Ans. Yes, she and her son, Richard, both have offices nearby. They both live in Nairobi.

4. Have you had any more recent publications since the June 78 Human Nature article?

Ans. Yes. I've written a review article in Annual Reviews of Anthropology and one or two technical reports on my work in Pakistan.

5. Would you elaborate more on the new data which made you change your position on human origins?

Ans. My change in view was not due to the discovery of just one particular specimen. The recovery of various material made me realize that my previous statements, which had been made so adamantly, were really based on very little evidence. I began to wonder, if they were based on very little evidence, why had I held them so strongly? It made me think about the nature of scientific thinking. This precipitated a very profound change in my thinking - in my approach to analyzing data.

Many of the statements made in our field have very little to do with the "real" data, and a great deal to do with unstated assumptions.

6. Do you feel this applies across the board to more than just human evolution - how about some of the other areas of evolution?

Ans. Much of what is said in other areas I think is also highly speculative.

7. Drs. Eldredge and Gould are saying alot these days about misconceptions people have about the fossil record. They say it really doesn't show evidence for gradualism but rather discontinuity between major taxa. What do you think of their ideas?

Ans. They say there are two ways to look at the evolutionary story, the punctuated way and the gradual way. Before they came along and pointed out that there were two ways, people emphatically said that there was only one way. They proposed an alternative way which they believed was correct and true. As far as I can see, it would be very difficult to tell for most mammal groups which would be correct.

8. Among practicing paleontologists who know what the fossil record shows, do you find agreement with Gould and Eldredge or do they think they are off base?

Ans. There is a mixed reaction. In alot of cases, the reasons for disagreement are philosophical rather than empirical. My thinking is that much of the fossil record is not adequate to help you decide which is the correct mode, so the mode that you choose to embrace is the one which you find yourself at ease with.

9. That gets back to your point that your preconceived notions shape the way that you perceive data.

Ans. Absolutely.

10. What we are trying to do is sift out the facts from the conjecture that is based on preconceived notions and biases - to present an objective picture to students in public schools.

Ans. It is difficult to do that because no scientist is free from biases. Much of what he says about the facts he collects is based upon his theoretical position.

11. What would you put in a textbook about human origins that is as far as possible free of preconceived ideas? For instance, do you agree with Richard Leakey that Skull 1470 represents the first appearance of *Homo sapiens*?

Ans. He says that it represents an early member of the genus "*Homo*," not necessarily *Homo sapiens*. It depends on how you define *Homo sapiens*: they are normally defined as modern humans.

At the moment we don't know how old they are because we don't have a decent dating technique that works during the time they evolved (80,000 to 40,000 years ago) but that is being developed very rapidly these days.

12. Geoffrey Bourne today is saying we've been wrong, apes and monkeys evolved from man. Do people take him seriously?

Ans. I don't know what he means by that.

13. Dr. Johanson is getting alot of publicity lately over Lucy. I understand that a number of people are questioning whether Lucy walked upright. Charles Oxnard was one. Do you think Lucy walked upright?

Ans. I'm not in a very good technical position to judge that. Alot of the evidence is of a circumstantial nature. I think she walked upright but it is also very likely that she wasn't walking around upright in exactly the way that we do.

14. What do you think of the multivariate analyses being done by Charles Oxnard where he takes many precise measurements of specimens and then correlates them with various groups of living primates? Are they better than someone just making an eyeball judgement of a specimen?

Ans. I think the jury is still out on that. I fluctuate in my thinking about the use of them. There are all sorts of problems if you are studying the interpretation of a specimen that is very different from anything else.

15. What do you think of Lord Zuckerman's work described in his book, Beyond the Ivory Tower?

Ans. I have not seen it.

Reply That would be a great book for you to read because he has much the same theme that you have in your article: that many people have had ideas and generalizations which would lead you to believe one thing but careful detailed analysis shows that the exact opposite is really more probable.

16. What would you say is the best evidence of a sequence showing the origin of man from some other animal?

Ans. Something like a Procounsel africanus from something like Aegyptopithecus, then to Ramapithecus and Australopithecus afarensis. Some of those links are very approximate. What you are really doing is comparing things that are very different. Ramapithecus is probably similar to the African genus that lived about eight million years ago which was the ancestor of A. afarensis, except we don't know what that African stock looked like for we don't have any fossils of it.

17. It must be very frustrating to be trying to put together puzzles with most of the pieces missing.

Ans. You have to sit back and try to figure out what you can do with what you've got.

18. What do you think of the latest find reported a week ago called Aegyptopithecus?

Ans. It's probably representative of what human ancestors looked like about thirty five million years ago.

19. Why do you think there is so much publicity given to it lately?

Ans. They do it for the same reason all the rest of us do, so that they can raise more money! Also, it is an important species and they have discovered significant new material of it.

20. Was Ramapithecus on the direct line to man?

Ans. All I'll say is: the known Ramapithecus from Asia was probably not on the line to man. The known Ramapithecus from Asia are eight million years old. Eight million years ago, the ancestors of Australopithecus and Homo would probably have been in Africa, but we don't know what they looked like. We can only guess that he looked something like Ramapithecus.

21. What is the current dating technique used to date your fossils?

Ans. Fission tracks, the paleomagnetic properties of rocks and potassium-argon.

22. Where do you have the potassium-argon and other dating done?

Ans. We have fission track dating done by the United States Geological Service. The paleomagnetic dating is done by Columbia University.

23. I am familiar with some of our recent space discoveries which revealed a major problem with one of the basic assumptions of potassium-argon dating, namely the 300 to 1 ratio of argon-40 to argon-36. The ratios are vastly different on Mars and Venus. Has this rippled down and affected the confidence in the potassium-argon technique?

Ans. You would have to ask one of the specialist laboratories doing this dating, University of California at Berkeley, Geology.

24. In summary, what would you say should be put in a biology syllabus for public schools about the origin of man?

Ans. It should contain what actually has been found in the fossil record. What some of the problems are in connecting things together and what kind of range of interpretations could be made to put together a story.

25. Let me read some quotes from Dr. Gould's talk February 15, 1980 at an evolution conference at Hobart College.

"Everybody knows the fossil record doesn't provide much evidence for gradualism; it is full of gaps and discontinuities. These gaps are all attributed to the notorious imperfection of the record, but this is not an adequate explanation. The fossil record shows one thing which cannot be attributed to its imperfection; most species don't change. They may get a little bigger or bumpier but they remain the same species. This remarkable stasis has generally been ignored. If it doesn't agree with your ideas, you don't talk about it.... The fundamental reason why alot of paleontologists don't care much for gradualism is because the fossil record doesn't show gradual change and every paleontologist has known that ever since Cuvier. If you want to get around that you have to invoke the imperfection of the fossil record. Every paleontologist knows that most species, most species, don't change. That's bothersome if you are trained to believe that evolution ought to be gradual. In fact it virtually precludes your studying the very process you went into the school to study. Because you don't see it, that brings terrible distress."

As far as your field is concerned, do you think he is correct?

- Ans. In the case of primates there are not enough fossil hominoids, in particular the early species, to test that idea out.

26. In some of the new school materials we may see some of these new ideas presented.

- Ans. I certainly hope so.

27. There is alot of questioning going on and some people feel it is healthy.

- Ans. I do too.

28. If I send you a typed transcript of this interview will you edit and return it so it can be put on record with our New York State Education Department?

- Ans. Yes.

Reply Thank you, Dr. Pilbeam.

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